MINERALS YEARBOOK

Volume II

AREA REPORTS: DOMESTIC

UNITED STATES DEPARTMENT OF THE INTERIOR

1978-79

Minerals Yearbook

1978-79

Volume II

AREA REPORTS: DOMESTIC

U.S. DEPARTMENT OF THE INTERIOR
March 3, 1849

Prepared by staff of the

BUREAU OF MINES

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UNITED STATES DEPARTMENT OF THE INTERIOR • James G. Watt, Secretary

BUREAU OF MINES

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities to protect and conserve our land and water, energy and minerals, fish and wildlife, and park and recreation areas, and for the wise use of all these resources. The Department also has a major responsibility for American Indian reservation communities and for the people who live in Island Territories under U.S. administration.

U.S. GOVERNMENT PRINTING OFFICE

WASHINGTON : 1981

Foreword

The Federal Government, through the Minerals Yearbook and its predecessor volumes, has reported annually on mineral industry activities for 98 years. In the interest of expediting the release of minerals data, this edition of the Yearbook covers both 1978 and 1979. It discusses the performance of the worldwide mineral industry during 1978 and 1979 and provides background information to assist in interpreting developments during the years being reviewed. Content of the individual volumes follows:

Volume I, Metals and Minerals, contains chapters on virtually all metallic and nonmetallic mineral commodities important to the U.S. economy. In addition, it includes a chapter on mining and quarrying trends.

Volume II, Area Reports: Domestic, contains chapters on the mineral industry of each of the 50 States, the U.S. island possessions in the Pacific Ocean and the Caribbean Sea, and the Commonwealth of Puerto Rico. This volume also has a statistical summary.

Volume III, Area Reports: International, contains the latest available mineral data on more than 130 foreign countries and discusses the importance of minerals to the economies of these nations. Separate chapters review the international minerals industry in general and its relationship to the world economy and ocean minerals.

The Bureau of Mines continually strives to improve the value of its publications to its users. Therefore, the constructive comments and suggestions of readers of the Yearbook will be welcomed.

Director

Acknowledgments

The chapters of this volume were written by the State Mineral Specialists of the Bureau of Mines, located throughout the country.

The Statistical Summary chapter and the tabular material covering total State mineral production, value of mineral production by county, and economic indicators were prepared in the Branch of Domestic Data. The Branch of Publication Support Services reviewed the manuscripts upon which this volume was based to insure statistical consistency among the tables, figures, and text between this volume and Volume I, and between this volume and those of former years.

Compilations contained in this volume were based largely on statistical data and other facts provided by the mineral industries. The Bureau gratefully acknowledges the willing contribution of these essential data by both companies and individuals.

In the collection of statistical and other mineral-industry information, the Bureau of Mines was also assisted by various State agencies through cooperative agreements. Many of the chapters in Volume II were reviewed by staff members of these agencies; in some instances the staff members collaborated in preparing the chapters and are shown as coauthors. Our sincere appreciation for this assistance is extended to the following cooperating organizations:

Alabama: Geological Survey of Alabama.
Alaska: Alaska Department of Natural Resources.
Arizona: Arizona Bureau of Mines.
Arkansas: Arkansas Geological Commission.
California: California Department of Conservation, Division of Mines and Geology.
Colorado: Division of Mines of the State of Colorado.
Connecticut: Geological and Natural History Survey of Connecticut, Department of Environmental Protection.
Delaware: Delaware Geological Survey.
Florida: Bureau of Geology, Department of Natural Resources.
Georgia: Georgia Department of Natural Resources, Environmental Protection Division, Georgia Geologic Survey.
Hawaii: Department of Land and Natural Resources.
Idaho: Idaho Bureau of Mines and Geology, Idaho Department of Lands.
Illinois: Illinois State Geological Survey.
Indiana: Geological Survey, Indiana Department of Natural Resources.
Iowa: Iowa Geological Survey.
Kansas: State Geological Survey of Kansas.
Kentucky: Geological Survey of Kentucky.
Louisiana: Louisiana Geological Survey.
Maine: Maine Geological Survey.
Maryland: Maryland Geological Survey.
Massachusetts: Office of the State Geologist, Massachusetts Department of Environmental Quality.
Michigan: Geological Survey Division of the Michigan Department of Natural Resources.
Minnesota: Mineral Resources Research Center, University of Minnesota.
Mississippi: Bureau of Geology and Energy Resources, Mississippi Department of Natural Resources.

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Missouri: Division of Geology and Land Survey, Department of Natural Resources.
Montana: Montana Bureau of Mines and Geology.
Nebraska: Conservation and Survey Division of the University of Nebraska, Nebraska Geological Survey.
Nevada: Nevada Bureau of Mines and Geology.
New Hampshire: New Hampshire Department of Resources and Economic Development.
New Jersey: New Jersey Division of Natural Resources, Bureau of Geology and Topography.
New Mexico: New Mexico Department of Energy and Minerals.
New York: New York Geological Survey.
North Carolina: Division of Earth Resources, North Carolina Department of Natural and Economic Resources.
North Dakota: North Dakota Geological Survey.
Oklahoma: Oklahoma Geological Survey.
Oregon: Department of Geology and Mineral Industries.
Pennsylvania: Pennsylvania Bureau of Topographic and Geologic Survey, Department of Environmental Resources.
Puerto Rico: Department of Natural Resources.
Rhode Island: Department of Natural Resources.
South Carolina: South Carolina Geological Survey, State Division of Research and Statistical Services.
South Dakota: South Dakota Geological Survey.
Tennessee: Tennessee Division of Geology.
Texas: Bureau of Economic Geology, The University of Texas at Austin.
Utah: Utah Geological and Mineral Survey.
Vermont: Office of the State Geologist, Agency of Environmental Conservation.
Washington: Washington Division of Geology and Earth Resources.
West Virginia: West Virginia Geological and Economic Survey.
Wisconsin: Geological and Natural History Survey of Wisconsin.
Wyoming: Wyoming Geological Survey.

Albert E. Schreck, *Editor-in-Chief*

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Statistical Summary

By Rose L. Ballard[1]

This chapter summarizes data on crude nonfuel mineral production for the United States, its island possessions, and the Commonwealth of Puerto Rico. Included also are tables that show the principal nonfuel mineral commodities exported from and imported into the United States, and that compare world and U.S. mineral production. The detailed data from which these tables were derived are contained in the individual commodity chapters of volume I and in the State chapters of volume II of this edition of the Minerals Yearbook. Although crude mineral production may be measured at any of several stages of extraction and processing, the stage of measurement used in this chapter is what is normally termed "mine output." It usually refers to minerals or ores in the form in which they are first extracted from the ground, but customarily includes the output from auxiliary processing at or near the mines.

Because of inadequacies in the statistics available, some series deviate from the foregoing definition. For gold, silver, copper, lead, zinc, and tin, the quantities are recorded on a mine basis (as the recoverable content of ore sold or treated). However, the values assigned to these quantities are based on the average selling price of refined metal, not the mine value. Mercury is measured as recovered metal and valued at the average New York price for the metal.

The weight or volume units shown are those customarily used in the particular industries producing the commodities. Values shown are in current dollars, with no adjustments made to compensate for changes in the purchasing power of the dollar.

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[1] Statistical specialist, Branch of Domestic Data.

Table 1.—Value of crude nonfuel mineral production[1] in the United States, by mineral group

(Million dollars)

	Metals	Nonmetals	Total
1977[r]	5,228	11,702	16,930
1978	6,296	13,525	19,821
1979	8,517	15,449	23,966

[r] Revised.
[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Nonfuel mineral production[1] in the United States

Mineral	1977 Quantity	1977 Value (thousands)	1978 Quantity	1978 Value (thousands)	1979 Quantity	1979 Value (thousands)
METALS						
Antimony ore and concentrate short tons, antimony content	610	$1,320	W	W	W	W
Bauxite thousand metric tons, dried equivalent	2,013	28,018	1,669	$23,186	1,821	$24,875
Copper (recoverable content of ores, etc.) metric tons	1,364,368	2,009,297	1,357,579	1,990,323	1,441,148	2,955,737
Gold (recoverable content of ores, etc.) troy ounces	1,100,347	163,192	998,832	193,325	919,783	282,833
Iron ore, usable (excluding byproduct iron sinter) thousand long tons, gross weight	53,880	1,417,418	82,826	2,287,965	86,130	2,811,574
Lead (recoverable content of ores, etc.) metric tons	537,499	363,789	529,661	393,516	525,569	609,929
Manganiferous ore (5% to 35% Mn) short tons, gross weight	215,893	2,249	312,124	3,074	240,696	2,902
Mercury 76-pound flasks	28,244	3,833	24,163	3,705	29,519	8,299
Molybdenum (content of concentrate) thousand pounds	124,974	450,421	130,694	607,950	143,504	871,067
Nickel (content of ore and concentrate) short tons	14,347	W	13,509	W	15,065	W
Silver (recoverable content of ores, etc.) thousand troy ounces	38,166	176,325	39,385	212,681	38,055	422,032
Titanium concentrate:						
Ilmenite short tons, gross weight	542,333	25,200	580,878	25,629	646,399	32,965
Tungsten ore and concentrate thousand pounds contained W	6,022	55,073	6,901	56,691	6,646	55,785
Vanadium (recoverable in ore and concentrate) short tons	6,504	74,488	4,272	56,776	5,520	73,892
Zinc (recoverable content of ores, etc.) metric tons	407,889	309,338	302,669	206,854	267,341	219,841
Combined value of beryllium, magnesium chloride for magnesium metal, rare-earth metals, tin, titanium (rutile), zircon concentrate, and values indicated by symbol W	XX	147,567	XX	133,849	XX	144,962
Total metals	XX	5,228,000	XX	6,296,000	XX	8,517,000
NONMETALS (EXCEPT FUELS)						
Abrasive stones[2] short tons	2,200	3,236	487	1,283	1,944	1,714
Asbestos do	101,704	25,267	102,632	27,967	102,903	28,925
Asphalt and related bitumens, native:						
Bituminous limestone, sandstone, gilsonite do	1,237,000	13,874	1,697,300	19,283	1,614,500	25,622
Barite thousand short tons	1,494	30,264	2,112	43,981	1,937	48,024
Boron minerals do	1,469	236,163	1,554	279,927	1,390	310,211
Bromine thousand pounds	433,818	99,678	446,548	100,003	503,200	117,000
Calcium chloride short tons	710,365	45,048	773,136	53,869	719,709	51,884
Carbon dioxide, natural thousand cubic feet	1,617,149	351	2,014,914	2,568	2,028,045	3,243
Cement:						
Portland thousand short tons	75,514	2,727,564	80,010	3,239,590	78,978	3,650,436
Masonry do	3,752	169,101	4,128	208,566	3,748	204,797
Clays do	53,196	579,171	56,822	717,274	54,689	846,089
Diatomite do	648	63,870	651	72,429	717	90,323
Feldspar short tons	733,963	17,186	734,870	18,185	740,472	21,474
Fluorspar do	169,489	16,479	129,426	13,262	109,290	12,162
Garnet (abrasive) do	20,022	2,234	29,732	2,335	21,240	1,975
Gem stones[3]	NA	8,850	NA	8,900	NA	8,290
Gypsum thousand short tons	13,390	74,341	14,891	92,726	14,630	99,868
Helium:						
Crude million cubic feet	537	6,443	549	6,582	611	7,327
High-purity do	957	24,290	1,001	25,276	1,062	26,847
Lime thousand short tons	19,947	666,472	20,443	749,667	20,945	862,459
Magnesium compounds from seawater and brine (except for metal) short tons, MgO equivalent	830,475	127,716	W	W	W	W
Mica:						
Scrap thousand short tons	176	[r]7,344	182	8,085	175	7,814
Sheet pounds	W	W	W	W	--	--
Peat thousand short tons	726	12,520	750	12,966	796	15,517
Perlite short tons	597,000	10,753	641,000	13,740	660,000	16,435
Phosphate rock thousand metric tons	47,256	821,657	50,037	928,820	51,611	1,045,655
Potassium salts thousand metric tons, K_2O equivalent	2,253	206,872	2,307	226,408	2,288	279,199
Pumice thousand short tons	[r]4,009	11,965	4,757	14,455	4,414	15,961
Pyrites thousand metric tons	442	7,003	778	12,326	1,049	17,087

See footnotes at end of table.

Table 2.—Nonfuel mineral production[1] in the United States —Continued

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NONMETALS (EXCEPT FUELS) —Continued						
Salt thousand short tons	42,412	$451,579	42,869	$499,345	45,793	$538,352
Sand and gravel do.	929,200	2,028,000	996,200	2,302,000	979,000	2,427,000
Sodium carbonate (natural) do.	6,228	337,516	6,790	371,255	W	W
Sodium sulfate (natural) thousand short tons	636	29,313	605	27,896	533	29,089
Stone[3] do.	955,371	2,456,932	1,050,900	2,885,689	1,098,617	3,398,968
Sulfur, Frasch process thousand metric tons	6,080	294,733	5,736	279,918	7,587	449,433
Talc, soapstone, pyrophyllite short tons	1,304,835	13,065	1,383,752	15,767	1,452,738	20,364
Tripoli do.	125,061	777	118,671	756	116,000	6,279
Vermiculite thousand short tons	359	18,579	337	19,734	346	21,365
Combined value of aplite, emery, graphite, iodine, kyanite, lithium minerals, magnesite, greensand marl, olivine, staurolite, wollastonite, and values indicated by symbol W	XX	56,048	XX	222,567	XX	740,589
Total nonmetals	XX	[r]11,702,000	XX	13,525,000	XX	15,449,000
Grand total	XX	[r]16,930,000	XX	19,821,000	XX	22,966,000

[e]Estimate. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Grindstones, pulpstones, grinding pebbles, sharpening stones, and tube mill liners.

[3] Excludes abrasive stone, bituminous limestone, bituminous sandstone, and soapstone, all included elsewhere in table.

Table 3.—Nonfuel minerals produced in the United States and principal producing States in 1979

Mineral	Principal producing States, in order of quantity	Other producing States
METALS and NONMETALS		
Antimony ore and concentrate	Idaho and Mont.	
Aplite	Va.	
Asbestos	Calif., Vt., Ariz.	
Asphalt (native)	Tex., Utah, Ala., Mo.	
Barite	Nev., Mo., Ga.	Ill., Mont., N. Mex., Tenn.
Bauxite	Ark., Ala., Ga.	
Beryllium concentrate	Utah.	
Boron minerals	Calif.	
Bromine	Ark. and Mich.	
Calcium-chloride	Mich. and Calif.	
Carbon dioxide (natural)	N. Mex., Colo., Utah, Calif.	
Cement	Calif., Tex., Pa., Mich	All other States except Alaska, Conn., Del., Mass., Minn., N.H., N.J., N. Dak., R.I., Vt.
Clays	Ga., Tex., Wyo., N.C.	All other States except Alaska, Hawaii, R.I., Vt.
Copper (mine)	Ariz., Utah, N. Mex., Mont	Calif., Colo., Idaho, Mich., Mo., Nev., Oreg., Tenn., Wash.
Diatomite	Calif., Nev., Wash., Oreg.	
Emery	N.Y.	
Feldspar	N.C., Conn., Ga., Okla	Calif., S. Dak., Wyo.
Fluorspar	Ill., Nev., Tex., Ariz.	
Garnet, abrasive	N.Y., Idaho, Maine.	
Gold (mine)	Utah, S. Dak., Nev., Ariz.	Alaska, Calif., Colo., Idaho, Mo., Mont., N. Mex., Oreg., Wash.
Graphite	Tex.	
Gypsum	Mich., Tex., Iowa, Calif	Ariz., Ark., Colo., Idaho, Ind., Kans., La., Mont., Nev., N. Mex., N.Y., Ohio, Okla., S. Dak., Utah, Va., Wash., Wyo.
Helium	Kans., Tex., Okla.	
Iodine	Okla. and Mich.	
Iron ore	Minn., Mich., Calif., Wyo.	Colo., Mo., Mont., Nev., N.Y., S. Dak., Tex., Utah, Wis.
Kyanite	Va. and Ga.	
Lead (mine)	Mo., Idaho, Colo., Va	Ariz., Calif., Ill., Mont., Nev., N. Mex., N.Y., Oreg., Tenn., Utah, Wash., Wis.
Lime	Ohio, Pa., Mo., Tex	All other States except Alaska, Del., Ga., Maine, N.H., N.C., R.I., S.C., Vt.
Lithium minerals	N.C. and Nev.	
Magnesite	Nev.	
Magnesium chloride	Tex.	
Magnesium compounds	Mich., Calif., N.J., Fla	Del., Miss., Tex., Utah.
Manganiferous ore	Minn., N. Mex., S.C.	
Marl, greensand	N.J.	
Mercury	Nev. and Calif.	
Mica, scrap	N.C., S.C., N. Mex., Ala.	Conn., Ga., Pa., S. Dak.
Molybdenum	Colo., Ariz., Utah, N. Mex	Calif. and Nev.
Nickel	Oreg.	
Olivine	Ill., N.C., Wash.	
Peat	Mich., Fla., Ill., Ind	Calif., Colo., Ga., Iowa, Maine, Md., Mass., Minn., Mont., N.J., N. Mex., N.Y., N. Dak., Ohio, Pa., S.C., Wash., Wis.
Perlite	N. Mex., Calif., Ariz., Idaho	Colo., Nev., Utah.
Phosphate rock	Fla., Idaho, N.C., Tenn	Ala., Mont., Utah, Wyo.
Potassium salts	N. Mex., Utah, Calif.	
Pumice	Ariz., Calif., Oreg., Nev.	Colo., Hawaii, Idaho, Kans., N. Mex., Okla., Utah.
Pyrites, ore and concentrate	Tenn., Colo., Ariz.	
Rare-earth metal concentrate	Calif. and Fla.	
Salt	La., Tex., N.Y., Ohio	Ala., Ariz., Calif., Colo., Hawaii, Kans., Mich., Nev., N. Mex., N. Dak., Okla., Utah, W. Va.
Sand and gravel	Calif., Tex., Alaska, Mich	All other States.
Silver (mine)	Idaho, Ariz., Mont., Colo	Alaska, Calif., Ill., Mich., Mo., Nev., N. Mex., N.Y., Oreg., S. Dak., Tenn., Utah, Wash.
Sodium carbonate (natural)	Wyo. and Calif.	
Sodium sulfate (natural)	Calif., Tex., Utah.	
Staurolite	Fla.	
Stone	Pa., Tex., Ill., Ga.	All other States except Del. and N. Dak.
Sulfur (Frasch)	Tex. and La.	
Talc, soapstone, pyrophyllite	Vt., Mont., N.Y., Tex	Ark., Calif., Ga., Iowa, Nev., N.C., Oreg., Va.
Tin	Alaska and Colo.	
Titanium concentrate	Fla., N.Y., N.J.	
Tripoli	Ill., Okla., Ark., Pa.	
Tungsten concentrate	Calif., Colo., Nev., Utah	Alaska, Ariz., Mont., Wash.
Uranium	N. Mex., Wyo., Tex., Colo	Fla., Utah, Wash.
Vanadium	Colo., Utah, Ark., Idaho	N. Mex.
Vermiculite	Mont., S.C., Va.	
Wollastonite	N.Y.	
Zinc (mine)	Tenn., Mo., N.J., Idaho	Ariz., Calif., Colo., Ill., Mont., Nev., N. Mex., N.Y., Pa., Utah, Va., Wis.
Zircon concentrate	Fla.	

Table 4.—Value of nonfuel mineral production in the United States and principal nonfuel minerals produced

State	Value (thousands)	Rank	Percent of U.S. total	Principal minerals, in order of value
1978				
Alabama	$331,239	19	1.67	Cement, stone, lime, sand and gravel.
Alaska	163,661	34	.82	Sand and gravel, stone, gold, gem stones.
Arizona	1,704,632	2	8.60	Copper, molybdenum, cement, sand and gravel.
Arkansas	265,065	23	1.33	Bromine, cement, stone, sand and gravel.
California	1,511,690	3	7.62	Cement, sand and gravel, boron minerals, stone.
Colorado	641,830	8	3.23	Molybdenum, cement, sand and gravel, vanadium.
Connecticut	53,612	43	.27	Sand and gravel, stone, feldspar, lime.
Delaware	[1]2,476	50	.01	Sand and gravel, magnesium compounds, clays.
Florida	1,098,772	6	5.54	Phosphate rock, stone, cement, sand and gravel.
Georgia	588,114	10	2.96	Clays, stone, cement, sand and gravel.
Hawaii	52,748	44	.26	Cement, stone, sand and gravel, pumice.
Idaho	299,227	20	1.50	Silver, phosphate rock, lead, zinc.
Illinois	439,554	15	2.21	Stone, sand and gravel, cement, lime.
Indiana	290,989	22	1.46	Cement, stone, sand and gravel, lime.
Iowa	259,560	25	1.30	Cement, stone, sand and gravel, gypsum.
Kansas	230,016	27	1.16	Cement, salt, stone, sand and gravel.
Kentucky	191,347	29	.96	Stone, lime, sand and gravel, cement.
Louisiana	356,255	17	1.79	Salt, sulfur, sand and gravel, cement.
Maine	42,782	46	.21	Sand and gravel, cement, stone, gem stones.
Maryland	164,635	33	.83	Stone, cement, sand and gravel, clays.
Massachusetts	90,068	41	.45	Stone, sand and gravel, lime, clays.
Michigan	1,359,590	4	6.85	Iron ore, cement, sand and gravel, magnesium compounds.
Minnesota	1.724,735	1	8.70	Iron ore, sand and gravel, stone, lime.
Mississippi	96,824	40	.48	Sand and gravel, cement, clays, magnesium compounds.
Missouri	866,464	7	4.37	Lead, cement, stone, lime.
Montana	205,800	28	1.03	Copper, cement, silver, sand and gravel.
Nebraska	83,373	42	.42	Cement, sand and gravel, stone, lime.
Nevada	237,409	26	1.19	Gold, barite, copper, sand and gravel.
New Hampshire	23,172	47	.11	Sand and gravel, stone, clays, gem stones.
New Jersey	127,856	37	.64	Stone, sand and gravel, zinc, titanium concentrate.
New Mexico	477,559	14	2.40	Copper, potassium salts, molybdenum, cement.
New York	418,542	16	2.11	Cement, stone, salt, sand and gravel.
North Carolina	294,578	21	1.48	Stone, phosphate rock, sand and gravel, cement.
North Dakota	22,137	48	.11	Sand and gravel, salt, lime, clays.
Ohio	553,349	11	2.79	Stone, lime, sand and gravel, cement.
Oklahoma	184,707	30	.93	Cement, stone, sand and gravel, helium.
Oregon	128,843	36	.65	Sand and gravel, stone, cement, nickel.
Pennsylvania	629,513	9	3.17	Cement, stone, lime, sand and gravel.
Rhode Island	7,493	49	.03	Sand and gravel, stone, gem stones.
South Carolina	182,801	31	.92	Cement, stone, clays, sand and gravel.
South Dakota	114,759	38	.57	Gold, cement, stone, sand and gravel.
Tennessee	346,842	18	1.74	Stone, cement, zinc, sand and gravel.
Texas	1,154,160	5	5.82	Cement, sulfur, stone, sand and gravel.
Utah	552,632	12	2.78	Copper, molybdenum, gold, cement.
Vermont	47,833	45	.24	Stone, asbestos, sand and gravel, talc.
Virginia	264,897	24	1.33	Stone, cement, lime, sand and gravel.
Washington	180,433	32	.91	Cement, sand and gravel, stone, lime.
West Virginia	103,518	39	.52	Stone, sand and gravel, cement, salt.
Wisconsin	159,226	35	.80	Sand and gravel, stone, iron ore, lime.
Wyoming	493,069	13	2.48	Sodium carbonate, clays, iron ore, sand and gravel.
Total	19,821,000	XX	100.00	
1979				
Alabama	336,367	21	1.40	Cement, stone, lime, clays.
Alaska	123,419	38	.51	Sand and gravel, stone, gold, tin.
Arizona	2,490,481	1	10.39	Copper, molybdenum, cement, silver.
Arkansas	302,622	24	1.26	Bromine, cement, stone, sand and gravel.
California	1,769,675	3	7.38	Cement, sand and gravel, boron minerals, stone.
Colorado	826,098	8	3.44	Molybdenum, cement, sand and gravel, silver.
Connecticut	69,236	43	.28	Stone, sand and gravel, feldspar, lime.
Delaware	[1]3,290	50	([2])	Sand and gravel, magnesium compounds, clays.
Florida	1,269,671	6	5.29	Phosphate rock, stone, cement, sand and gravel.
Georgia	698,690	11	2.91	Clays, stone, cement, sand and gravel.
Hawaii	63,904	44	.26	Cement, stone, sand and gravel, pumice.
Idaho	437,885	18	1.82	Silver, phosphate rock, lead, zinc.
Illinois	476,530	15	1.98	Stone, sand and gravel, cement, lime.
Indiana	326,086	22	1.36	Cement, stone, sand and gravel, lime.
Iowa	277,901	26	1.15	Cement, stone, sand and gravel, gypsum.
Kansas	263,392	27	1.09	Cement, salt, stone, sand and gravel.
Kentucky	207,927	30	.86	Stone, lime, cement, sand and gravel.
Louisiana	455,276	16	1.89	Sulfur, salt, sand and gravel, cement.
Maine	45,910	46	.19	Sand and gravel, cement, stone, gem stones.
Maryland	192,962	33	.80	Stone, cement, sand and gravel, clays.
Massachusetts	92,546	42	.38	Stone, sand and gravel, lime, clays.
Michigan	1,506,476	4	6.28	Iron ore, cement, sand and gravel, magnesium compounds.

See footnotes at end of table.

Table 4.—Value of nonfuel mineral production in the United States and principal nonfuel minerals produced —Continued

State	Value (thousands)	Rank	Percent of U.S. total	Principal minerals, in order of value
1979 —Continued				
Minnesota	$2,067,990	2	8.62	Iron ore, sand and gravel, stone, lime.
Mississippi	107,689	40	.44	Sand and gravel, cement, clays, magnesium compounds.
Missouri	1,159,835	7	4.83	Lead, cement, stone, lime.
Montana	291,287	25	1.21	Copper, silver, cement, sand and gravel.
Nebraska	99,181	41	.41	Cement, sand and gravel, stone, lime.
Nevada	238,150	28	.99	Gold, barite, sand and gravel, diatomite.
New Hampshire	23,258	47	.09	Sand and gravel, stone, clays, gem stones.
New Jersey	151,689	36	.63	Stone, sand and gravel, zinc, titanium concentrate.
New Mexico	694,448	12	2.89	Copper, potassium salts, molybdenum, sand and gravel.
New York	453,710	17	1.89	Cement, stone, salt, sand and gravel.
North Carolina	342,286	20	1.42	Stone, phosphate rock, sand and gravel, cement.
North Dakota	21,234	48	.08	Sand and gravel, salt, lime, clays.
Ohio	607,320	13	2.53	Stone, lime, sand and gravel, cement.
Oklahoma	201,022	32	.84	Cement, stone, sand and gravel, helium.
Oregon	165,207	35	.68	Stone, sand and gravel, cement, nickel.
Pennsylvania	722,614	10	3.01	Cement, stone, lime, sand and gravel.
Rhode Island	7,886	49	.03	Sand and gravel, stone, gem stones.
South Carolina	201,711	31	.84	Cement, stone, sand and gravel, clays.
South Dakota	148,686	37	.62	Gold, cement, stone, sand and gravel.
Tennessee	385,744	19	1.60	Stone, zinc, cement, sand and gravel.
Texas	1,406,168	5	5.86	Cement, sulfur, stone, sand and gravel.
Utah	753,384	9	3.14	Copper, gold, molybdenum, cement.
Vermont	54,136	45	.22	Stone, asbestos, sand and gravel, talc.
Virginia	309,765	23	1.29	Stone, cement, lime, sand and gravel.
Washington	224,948	29	.93	Cement, sand and gravel, stone, lime.
West Virginia	118,595	39	.49	Stone, sand and gravel, cement, salt.
Wisconsin	179,682	34	.74	Sand and gravel, stone, iron ore, lime.
Wyoming	590,176	14	2.46	Sodium carbonate, clays, iron ore, stone.
Total	23,966,000	XX	100.00	

XX Not applicable.

[1] Incomplete total.

[2] Less than 1/2 unit.

Table 5.—Value of nonfuel mineral production per capita and per square mile in 1979, by State

State	Area (square miles)	1979 Population (thousands)	Value of mineral production				
			Total (thousands)	Per square mile		Per capita	
				Dollars	Rank	Dollars	Rank
Alabama	51,609	3,769	$336,367	6,518	23	89	22
Alaska	586,412	406	123,419	210	50	304	9
Arizona	113,909	2,450	2,490,481	21,864	3	1,017	2
Arkansas	53,104	2,180	302,622	5,699	29	139	15
California	158,693	22,694	1,769,675	11,152	13	78	24
Colorado	104,247	2,772	826,098	7,924	21	298	10
Connecticut	5,009	3,115	69,236	13,822	10	22	46
Delaware	2,057	582	[1]3,290	1,599	46	6	50
Florida	58,560	8,860	1,269,671	21,682	4	143	14
Georgia	58,876	5,117	698,690	11,867	11	137	16
Hawaii	6,450	915	63,904	9,908	14	70	25
Idaho	83,557	905	437,885	5,241	32	484	6
Illinois	56,400	11,229	476,530	8,449	20	42	40
Indiana	36,291	5,400	326,086	8,985	18	60	33
Iowa	56,290	2,902	277,901	4,937	34	96	21
Kansas	82,264	2,369	263,392	3,202	37	111	18
Kentucky	40,395	3,527	207,927	5,147	33	59	35
Louisiana	48,523	4,018	455,276	9,383	15	113	17
Maine	33,215	1,097	45,910	1,382	47	42	41
Maryland	10,577	4,148	192,962	18,244	6	47	38
Massachusetts	8,257	5,769	92,546	11,208	12	16	48
Michigan	58,216	9,207	1,506,476	25,877	1	164	13
Minnesota	84,068	4,060	2,067,990	24,599	2	509	5
Mississippi	47,716	2,429	107,689	2,257	41	44	39
Missouri	69,686	4,867	1,159,835	16,644	7	238	11
Montana	147,138	786	291,287	1,980	43	371	7
Nebraska	77,227	1,574	99,181	1,284	48	63	29
Nevada	110,540	702	238,150	2,154	42	339	8
New Hampshire	9,304	887	23,258	2,500	40	26	45
New Jersey	7,836	7,332	151,689	19,358	5	21	47
New Mexico	121,666	1,241	694,448	5,708	28	560	3
New York	49,576	17,648	453,710	9,152	16	26	44
North Carolina	52,586	5,606	342,286	6,509	24	61	32
North Dakota	70,665	657	21,234	300	49	32	43
Ohio	41,222	10,731	607,320	14,733	9	57	36
Oklahoma	69,919	2,892	201,022	2,875	39	70	26
Oregon	96,981	2,527	165,207	1,703	45	65	28
Pennsylvania	45,333	11,731	722,614	15,940	8	62	31
Rhode Island	1,214	929	7,886	6,496	25	8	49
South Carolina	31,055	2,932	201,711	6,495	26	69	27
South Dakota	77,047	689	148,686	1,930	44	216	12
Tennessee	42,244	4,380	385,744	9,131	17	88	23
Texas	267,338	13,380	1,406,168	5,260	31	105	20
Utah	84,916	1,367	753,384	8,872	19	551	4
Vermont	9,609	493	54,136	5,634	30	110	19
Virginia	40,817	5,197	309,765	7,589	22	60	34
Washington	68,192	3,926	224,948	3,299	36	57	37
West Virginia	24,181	1,878	118,595	4,904	35	63	30
Wisconsin	56,154	4,720	179,682	3,200	38	38	42
Wyoming	97,914	450	590,176	6,027	27	1,312	1
Total[2]	3,615,055	219,442	23,966,000	6,629	XX	109	XX

XX Not applicable.

[1] Incomplete total.

[2] Excludes Washington, D.C., with an area of 67 square miles and a population of 657,000 (which had no mineral production).

Table 6.—Nonfuel mineral production[1] in the United States, by State

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
ALABAMA						
Cement:						
Masonry thousand short tons	345	$14,255	356	$17,238	303	$13,930
Portland do	2,351	79,302	2,837	108,972	2,578	103,187
Clays[2] do	2,677	21,984	2,782	24,885	2,571	33,824
Gem Stones	--	--	NA	1	NA	2
Lime thousand short tons	1,149	39,213	1,264	49,021	1,273	54,182
Sand and gravel do	14,372	35,204	15,290	35,690	13,747	31,319
Stone:						
Crushed do	25,248	72,649	26,572	82,767	26,443	83,566
Dimension do	14	1,715	13	1,739	12	2,071
Combined value of asphalt (native), bauxite, clays (bentonite), mica (crude), phosphate rock (1978-79), and salt	XX	6,036	XX	10,871	XX	14,286
Total	XX	270,358	XX	331,239	XX	336,367
ALASKA						
Gem stones	NA	60	NA	60	NA	60
Gold (recoverable content of ores, etc.) troy ounces	18,962	2,812	18,652	3,610	6,675	2,053
Sand and gravel thousand short tons	66,426	134,251	69,300	145,300	50,900	104,905
Silver (recoverable content of ores, etc.) troy ounces	2,000	8	2,000	11	(3)	5
Stone:						
Crushed thousand short tons	4,008	17,493	3,437	14,649	3,656	15,458
Dimension do	(3)	1	--	--	--	--
Combined value of copper (1977-78), tin (1978-79), and tungsten	XX	10	XX	31	XX	938
Total	XX	154,635	XX	163,661	XX	123,419
ARIZONA						
Clays thousand short tons	[2]33	[2]444	143	731	138	642
Copper (recoverable content of ores, etc.) metric tons	838,033	1,234,168	891,409	1,306,866	946,002	1,940,211
Gem stones	NA	4,500	NA	4,600	NA	4,000
Gold (recoverable content of ores, etc.) troy ounces	90,167	13,373	92,989	17,998	101,840	31,316
Gypsum thousand short tons	187	775	184	955	231	1,245
Lead (recoverable content of ores, etc.) metric tons	288	195	416	309	354	411
Lime thousand short tons	474	15,528	498	19,743	673	27,186
Molybderum (content of concentrate) thousand pounds	34,574	120,497	W	W	35,101	213,065
Pumice thousand short tons	621	1,226	1,135	3,130	940	2,367
Sand and gravel do	22,313	[r]49,946	28,310	69,100	[4]30,520	[4]74,716
Silver (recoverable content of ores, etc.) thousand troy ounces	6,828	31,546	6,638	35,844	7,479	82,941
Stone:						
Crushed thousand short tons	5,359	16,367	5,306	17,669	5,769	21,401
Dimension do	[r]8	[r]128	5	101	5	110
Zinc (recoverable content of ores, etc.) metric tons	3,973	[r]3,013	W	W	W	W
Combined value of asbestos, cement, clays (ball clay, common clay, and fire clay, 1977), feldspar (1977-78), fluorspar, mica (crude, 1977), perlite, pyrites, salt, sand and gravel (industrial, 1979), tungsten, and values indicated by symbol W	XX	63,082	XX	227,586	XX	90,870
Total	XX	1,554,788	XX	1,704,632	XX	2,490,481
ARKANSAS						
Bauxite thousand metric tons	1,708	24,851	1,446	21,103	1,430	20,555
Clays thousand short tons	988	5,407	1,137	5,119	1,044	7,686
Gem stones	NA	85	NA	150	NA	150
Lime thousand short tons	152	4,552	171	5,708	160	6,287
Sand and gravel do	16,110	36,091	16,900	36,510	16,465	35,200
Stone:						
Crushed do	18,310	45,448	19,960	53,461	19,978	53,722
Dimension do	13	368	11	223	14	528
Combined value of abrasives, barite (1977-78) bromine, cement, gypsum, soapstone, tripoli, and vanadium	XX	169,582	XX	142,791	XX	178,493
Total	XX	286,884	XX	265,065	XX	302,622

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
CALIFORNIA						
Asbestos ---------------short tons--	76,247	$18,372	70,728	$19,281	76,332	$20,434
Boron minerals --- thousand short tons--	1,469	236,163	1,554	279,927	1,590	310,211
Cement, portland --------------do----	9,271	406,185	9,290	473,486	9,724	541,815
Clays ---------------------do----	2,655	12,179	2,479	15,106	2,531	18,621
Copper (recoverable content of ores, etc.) metric tons--	200	295	W	W	W	W
Diatomite ------ thousand short tons--	397	43,405	379	48,998	422	60,989
Gem stones---------------------------	NA	230	NA	240	NA	240
Gold (recoverable content of ores, etc.) troy ounces--	5,704	846	7,480	1,448	3,195	982
Gypsum-------- thousand short tons--	1,629	8,500	1,578	9,017	1,624	10,354
Lead (recoverable content of ores, etc.) metric tons--	3	2	W	W	2	2
Lime --------- thousand short tons--	598	24,074	522	21,691	564	25,545
Mercury ----------- 76-pound flasks--	W	W	--	--	151	43
Pumice -------- thousand short tons--	636	3,838	831	3,458	800	3,973
Sand and gravel--------------do----	109,135	250,951	115,100	281,400	129,348	347,385
Silver (recoverable content of ores, etc.) thousand troy ounces--	58	267	58	313	64	712
Stone:						
Crushed------ thousand short tons--	34,011	80,146	37,856	93,377	39,742	106,227
Dimension ----------------do----	26	996	24	921	41	2,258
Talc -------------------short tons--	95,602	2,373	105,865	3,795	175,752	6,960
Zinc (recoverable content of ores, etc.) metric tons--	2	1	W	W	W	W
Combined value of calcium chloride, carbon dioxide, cement (masonry), feldspar, iron ore, lithium compounds (1977-78), magnesium compounds, molybdenum, peat, perlite, phosphate rock (1977), potassium salts, rare-earth concentrates, salt, sodium carbonates, sodium sulfate, tungsten, and values indicated by symbol W ----------	XX	241,064	XX	259,232	XX	312,924
Total ---------------------	XX	1,329,887	XX	1,511,690	XX	1,769,675
COLORADO						
Clays[3]--------- thousand short tons--	961	4,712	548	2,753	521	2,717
Copper (recoverable content of ores, etc.) metric tons--	1,720	2,533	1,191	1,747	362	742
Gem stones---------------------------	NA	100	NA	75	NA	70
Gold (recoverable content of ores, etc.) troy ounces--	72,668	10,777	32,094	6,212	13,850	4,259
Gypsum-------- thousand short tons--	211	1,121	235	882	275	1,727
Lead (recoverable content of ores, etc.) metric tons--	20,860	14,118	15,151	11,257	7,554	8,767
Lime --------- thousand short tons--	180	5,413	W	W	W	W
Peat ---------------------do----	32	195	30	188	33	299
Sand and gravel--------------do----	[4]23,910	[4]50,527	26,490	58,600	25,680	[4]56,263
Silver (recoverable content of ores, etc.) thousand troy ounces--	4,663	21,545	4,217	22,773	2,809	31,151
Stone:						
Crushed------ thousand short tons--	5,597	14,169	6,229	15,683	6,835	19,435
Dimension ----------------do----	5	181	5	178	3	163
Zinc (recoverable content of ores, etc.) metric tons--	36,529	27,704	22,208	15,178	9,910	8,149
Combined value of beryllium (1978), carbon dioxide, cement, clays (bentonite), feldspar (1977-78), iron ore, molybdenum, perlite, pumice, pyrites, salt, sand and gravel (industrial, 1977 and 1979), tin, tungsten concentrate, vanadium, and values indicated by symbol W ------------------	XX	384,445	XX	506,304	XX	692,356
Total ---------------------	XX	537,540	XX	641,830	XX	826,098
CONNECTICUT						
Clays --------- thousand short tons--	95	250	105	324	112	435
Lime ---------------------do----	29	1,412	29	1,564	33	2,058
Sand and gravel--------------do----	[4]8,543	[4]18,316	11,010	26,560	[4]9,990	[4]23,612
Stone:						
Crushed------------------do----	6,980	20,319	7,364	22,301	8,271	38,767
Dimension ----------------do----	9	240	9	240	13	475
Combined value of feldspar, gem stones, mica, and industrial sand (1977 and 1979)-----	XX	3,171	XX	2,623	XX	3,894
Total ---------------------	XX	43,708	XX	53,612	XX	69,236

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
DELAWARE						
Clays ---------- thousand short tons--	11	$7	10	$8	11	$9
Sand and gravel --------------do----	1,351	2,084	1,449	2,468	1,674	3,281
Total ----------------------	XX	[5]2,091	XX	[5]2,476	XX	[5]3,290
FLORIDA						
Cement:						
Masonry ----- thousand short tons--	W	W	W	W	255	13,098
Portland ----------------do----	2,540	87,561	2,766	111,892	2,957	126,562
Clays ---------------------do----	581	[2]22,313	601	28,850	681	[2]31,308
Gem stones------------------------	--	--	NA	5	NA	4
Lime ---------- thousand short tons--	165	7,350	180	8,182	210	11,440
Peat ----------------------do----	125	1,396	158	2,246	153	2,190
Sand and gravel ---------------do----	20,218	38,989	21,860	36,950	21,708	39,520
Stone (crushed) ---------------do----	[6]48,558	[6]101,435	57,354	128,905	W	W
Combined value of clays (kaolin, 1977 and 1979), magnesium compounds, phosphate rock, rare-earth concentrate, staurolite, stone (dimension, 1977), titanium concentrates (ilmenite and rutile), zircon concentrates, and values indicated by symbol W --	XX	702,832	XX	781,742	XX	1,045,549
Total ----------------------	XX	961,876	XX	1,098,772	XX	1,269,671
GEORGIA						
Cement:						
Masonry ----- thousand short tons--	W	W	W	W	102	5,172
Portland ----------------do----	1,192	37,711	1,435	51,504	1,335	55,117
Clays ---------------------do----	7,554	288,223	8,476	358,654	8,322	437,671
Gem stones------------------------	--	--	NA	20	NA	20
Sand and gravel --- thousand short tons--	5,141	13,207	5,378	12,550	[4]5,014	[4]10,792
Stone:						
Crushed-----------------do----	37,864	106,215	41,572	131,959	40,902	154,021
Dimension ---------------do----	240	13,637	277	15,879	244	17,908
Talc -------------------short tons--	23 540	63	W	W	W	W
Combined value of barite, bauxite, feldspar, iron ore (1977), kyanite, mica, peat, sand and gravel (industrial, 1979), and values indicated by symbol W ------------	XX	15,307	XX	17,548	XX	17,989
Total ----------------------	XX	474,363	XX	588,114	XX	698,690
HAWAII						
Cement:						
Portland ----- thousand short tons--	320	16,315	441	25,626	469	29,346
Masonry ----------------do----	10	607	11	828	12	1,077
Pumice ---------------------do----	260	574	272	658	359	1,240
Sand and gravel --------------do----	771	2,452	706	1,582	1,081	3,063
Stone:						
Crushed-----------------do----	5,758	19,876	6,027	23,845	6,868	28,969
Dimension ---------------do----	1	4	W	W	1	W
Combined value of other nonmetals and values indicated by symbol W ----------	XX	152	XX	209	XX	209
Total ----------------------	XX	39,980	XX	52,748	XX	63,904
IDAHO						
Antimony ore and concentrate, antimony content short tons--	446	W	W	W	W	W
Clays ---------- thousand short tons--	W	W	27	148	28	263
Copper (recoverable content of ores, etc.) metric tons--	3,676	5,413	3,888	5,701	3,618	7,421
Gem stones------------------------	NA	100	NA	50	NA	60
Gold (recoverable content of ores, etc.) troy ounces--	12,894	1,912	20,492	3,966	24,140	7,423
Lead (recoverable content of ores, etc.) metric tons--	42,872	29,016	44,761	33,256	42,636	49,479
Phosphate rock -- thousand metric tons--	W	W	4,461	80,765	4,880	95,728
Sand and gravel --- thousand short tons--	[4]7,750	[4]15,282	8,112	19,290	[4]7,719	[4]18,149
Silver (recoverable content of ores, etc.) thousand troy ounces--	15,292	70,649	18,379	99,249	17,144	190,129
Stone[6] --------- thousand short tons--	3,077	8,005	2,624	6,670	2,952	8,787

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
IDAHO—Continued						
Zinc (recoverable content of ores, etc.) metric tons	28,121	$21,327	32,353	$22,111	29,660	$24,391
Combined value of barite (1977-78), cement, garnet (abrasives), gypsum, lime, perlite, pumice, sand and gravel (industrial, 1977 and 1979), stone (dimension), tungsten ore (1977), vanadium, and values indicated by symbol W	XX	100,966	XX	28,021	XX	36,055
Total	XX	252,670	XX	299,227	XX	437,885
ILLINOIS						
Cement, portland thousand short tons	1,823	61,849	2,112	80,242	1,889	79,604
Clays[3] do	951	5,117	742	3,185	542	2,355
Fluorspar short tons	131,218	13,941	115,859	12,452	W	W
Gem stones	NA	2	NA	15	NA	15
Peat thousand short tons	82	1,478	84	1,594	86	1,610
Sand and gravel do	37,633	101,230	43,450	127,900	45,448	134,190
Stone:						
Crushed do	57,074	135,964	62,453	160,352	63,551	188,130
Dimension do	3	109	3	122	3	128
Combined value of barite, cement (masonry), clays (fuller's earth), lead, lime, silver, tripoli, zinc, and values indicated by symbol W	XX	48,641	XX	53,692	XX	70,498
Total	XX	368,331	XX	439,554	XX	476,530
INDIANA						
Cement, portland thousand short tons	W	W	W	W	2,389	95,549
Clays do	1,268	2,237	1,277	2,495	1,185	2,341
Peat do	51	759	57	789	76	1,242
Sand and gravel do	26,248	50,089	27,600	54,380	[4]27,050	[4]55,842
Stone:						
Crushed do	26,740	61,392	33,394	80,523	34,134	92,533
Dimension do	244	11,804	234	12,972	340	19,543
Combined value of abrasives (natural), cement (masonry), gypsum, lime, sand and gravel (industrial, 1979), and values indicated by symbol W	XX	120,445	XX	139,830	XX	59,036
Total	XX	246,726	XX	290,989	XX	326,086
IOWA						
Cement:						
Masonry thousand short tons	86	5,052	88	5,390	69	3,844
Portland do	2,645	99,383	2,646	107,335	2,371	109,628
Clays do	883	2,461	894	2,694	870	2,883
Gem stones	NA	1	--	--	--	--
Gypsum thousand short tons	1,593	10,035	1,602	12,175	1,695	13,777
Peat do	16	266	6	182	11	270
Sand and gravel do	[4]16,600	[4]33,290	[4]17,670	[4]37,310	17,495	39,686
Stone:						
Crushed do	29,183	76,964	31,310	88,618	32,471	103,215
Dimension do	W	W	10	480	10	508
Combined value of other nonmetals and values indicated by symbol W	XX	4,238	XX	5,376	XX	4,090
Total	XX	231,690	XX	259,560	XX	277,901
KANSAS						
Cement:						
Masonry thousand short tons	79	3,742	96	4,558	89	4,525
Portland do	2,020	72,815	2,083	78,717	2,086	88,619
Clays[3] do	1,117	1,965	1,161	2,314	1,061	2,636
Lime do	15	409	W	W	W	W
Salt[7] do	1,430	41,154	1,661	48,097	1,900	61,184
Sand and gravel do	[4]13,973	[4]23,299	[4]14,260	[4]24,330	14,280	26,490
Stone (crushed)[8] do	17,229	41,807	18,578	48,803	19,308	56,038

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1977 Quantity	1977 Value (thousands)	1978 Quantity	1978 Value (thousands)	1979 Quantity	1979 Value (thousands)
KANSAS—Continued						
Combined value of clays (bentonite), gypsum, helium (crude and high purity), pumice (1978-79), salt (brine), sand and gravel (industrial, 1977-78), stone (dimension), and values indicated by symbol W	XX	$22,627	XX	$23,197	XX	$23,900
Total	XX	207,818	XX	230,016	XX	263,392
KENTUCKY						
Clays thousand short tons	716	2,500	676	2,672	794	3,259
Gem stones	--	--	NA	1	NA	1
Sand and gravel thousand short tons	9,764	19,686	[4]13,180	[4]23,900	[4]11,726	[4]23,721
Stone (crushed) do	36,096	88,941	40,772	107,949	W	W
Zinc (recoverable content of ores, etc.) metric tons	--	--	52	35	--	--
Combined value of cement, clays (ball clay), fluorspar (1977-78), lead (1978), lime, sand and gravel (industrial, 1978-79), and values indicated by symbol W	XX	45,478	XX	56,790	XX	180,946
Total	XX	156,605	XX	191,347	XX	207,927
LOUISIANA						
Clays thousand short tons	401	785	517	4,786	416	6,073
Salt do	13,201	96,878	14,263	110,472	14,207	113,167
Sand and gravel do	21,987	50,790	22,010	56,080	[4]20,446	[4]54,081
Stone (crushed) do	9,710	26,920	9,130	26,921	W	W
Sulfur (Frasch) thousand metric tons	2,493	W	1,984	W	2,858	W
Combined value of cement, gypsum, lime, sand and gravel (1979), and values indicated by symbol W	XX	174,912	XX	157,996	XX	281,955
Total	XX	350,285	XX	356,255	XX	455,276
MAINE						
Clays thousand short tons	98	160	100	164	90	163
Copper (recoverable content of ores, etc.) metric tons	1,213	1,787	--	--	--	--
Gem stones	NA	W	NA	W	NA	W
Lead (recoverable content of ores, etc.) metric tons	161	109	--	--	--	--
Peat thousand short tons	5	80	4	153	3	202
Sand and gravel do	10,487	19,023	11,530	22,470	11,022	20,534
Stone (crushed) do	1,312	4,110	1,655	5,510	2,069	7,492
Zinc (recoverable content of ores, etc.) metric tons	6,594	5,001	--	--	--	--
Combined value of other nonmetals and values indicated by symbol W	XX	12,955	XX	14,485	XX	17,519
Total	XX	43,225	XX	42,782	XX	45,910
MARYLAND						
Clays[3] thousand short tons	893	2,344	948	2,642	975	2,854
Lime do	W	W	12	436	12	444
Peat do	3	W	W	W	3	W
Sand and gravel do	11,702	29,562	13,310	34,950	13,988	39,033
Stone:						
Crushed do	16,736	49,772	19,427	66,263	21,561	80,550
Dimension do	30	908	28	1,048	30	1,150
Combined value of cement, clays (ball clay), gem stones (1977), and values indicated by symbol W	XX	50,405	XX	59,296	XX	68,931
Total	XX	132,991	XX	164,635	XX	192,962
MASSACHUSETTS						
Clays thousand short tons	149	275	155	333	156	367
Lime do	W	W	199	8,478	198	9,918
Peat do	2	W	2	65	2	56
Sand and gravel do	16,639	34,346	[4]17,860	[4]37,460	[4]16,705	[4]37,164

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1977 Quantity	1977 Value (thousands)	1978 Quantity	1978 Value (thousands)	1979 Quantity	1979 Value (thousands)
MASSACHUSETTS—Continued						
Stone:						
Crushed thousand short tons	8,030	$30,501	8,398	$36,360	8,586	$39,570
Dimension do.	63	4,856	68	6,411	48	4,389
Combined value of other nonmetals and values indicated by symbol W	XX	7,290	XX	961	XX	1,082
Total	XX	77,268	XX	90,068	XX	92,546
MICHIGAN						
Cement:						
Masonry thousand short tons	246	9,761	294	13,621	262	16,455
Portland do.	5,582	166,803	5,916	211,786	5,682	252,058
Clays do.	2,007	5,126	2,122	6,993	2,072	7,430
Copper (recoverable content of ores, etc.) metric tons	38,442	56,613	W	W	W	W
Gem stones	NA	12	NA	10	NA	10
Gypsum thousand short tons	1,924	8,778	2,765	15,526	2,526	14,633
Iron ore (usable), thousand long tons, gross weight	12,009	356,227	17,538	556,954	17,196	596,478
Lime thousand short tons	1,347	42,015	1,291	45,814	1,057	43,373
Peat do.	226	3,917	220	3,851	258	4,847
Salt do.	3,939	78,808	3,741	83,872	3,080	82,540
Sand and gravel do.	46,486	101,542	48,260	107,600	50,169	116,597
Silver (recoverable content of ores, etc.) thousand troy ounces	335	1,550	W	W	W	W
Stone:						
Crushed thousand short tons	40,517	84,971	40,129	90,781	39,809	99,832
Dimension do.	8	147	8	155	9	166
Combined value of bromine, calcium chloride, iodine, magnesium compounds, and values indicated by symbol W	XX	138,626	XX	222,427	XX	272,057
Total	XX	1,054,896	XX	1,359,590	XX	1,506,476
MINNESOTA						
Clays[2] thousand short tons	163	276	174	2,090	135	1,905
Gem stones	NA	15	NA	5	NA	5
Iron ore (usable), thousand long tons, gross weight	30,245	782,627	56,473	1,627,099	59,682	1,965,710
Lime thousand short tons	123	4,315	116	4,263	140	5,133
Manganiferous ore short tons	166,440	W	253,399	W	181,503	W
Peat thousand short tons	28	1,280	20	716	21	827
Sand and gravel do.	30,713	59,629	[4]31,080	[4]54,970	[4]30,939	[4]55,427
Stone:						
Crushed do.	7,831	16,991	9,666	20,734	9,751	22,175
Dimension do.	33	8,133	35	9,356	38	11,543
Combined value of abrasive stone (1977 and 1979), clays (kaolin), sand and gravel (industrial, 1978-79), and values indicated by symbol W	XX	2,337	XX	5,502	XX	5,265
Total	XX	875,608	XX	1,724,735	XX	2,067,990
MISSISSIPPI						
Clays thousand short tons	[2]1,483	[2]8,841	1,960	19,623	1,820	21,841
Lime do.	49	1,079	49	1,108	70	1,571
Sand and gravel[4] do.	13,353	25,375	15,950	33,520	16,940	37,797
Stone (crushed) do.	2,176	3,933	2,409	5,176	W	W
Combined value of cement, clays (ball clay and fuller's earth, 1977), magnesium compounds, sand and gravel (industrial), and values indicated by symbol W	XX	38,240	XX	37,397	XX	46,480
Total	XX	77,468	XX	96,824	XX	107,689
MISSOURI						
Barite thousand short tons	117	4,061	121	4,661	89	3,679
Cement:						
Masonry do.	82	3,286	89	4,112	82	4,159
Portland do.	4,654	155,945	4,733	175,962	4,430	194,285
Clays do.	[2]2,373	[2]16,892	[2]2,258	[2]16,880	2,351	20,522

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
MISSOURI—Continued						
Copper (recoverable content of ores, etc.) metric tons	10,648	$15,681	10,818	$15,861	13,021	$26,705
Gem stones	--	--	NA	15	NA	10
Gold (recoverable content of ores, etc.) troy ounces	--	--	--	--	32	10
Lead (recoverable content of ores, etc.) metric tons	453,824	307,156	461,762	343,070	472,054	547,824
Lime thousand short tons	1,723	51,529	1,791	63,642	1,789	70,187
Sand and gravel do	14,002	31,473	15,560	33,660	12,558	31,310
Silver (recoverable content of ores, etc.) thousand troy ounces	2,363	10,916	2,056	11,103	2,201	24,410
Stone:						
Crushed thousand short tons	49,612	104,700	57,265	130,568	56,380	139,944
Dimension do	3	597	1	208	(3)	95
Zinc (recoverable content of ores, etc.) metric tons	74,107	56,203	59,038	40,349	61,682	50,723
Combined value of asphalt (native), clays (fuller's earth, 1977-78), iron ore, and phosphate rock (1977)	XX	67,950	XX	26,373	XX	45,982
Total	XX	826,389	XX	866,464	XX	1,159,835
MONTANA						
Antimony short tons	164	663	W	W	W	W
Barite thousand short tons	10	W	W	W	W	W
Clays do	224	3,557	217	3,699	424	11,508
Copper (recoverable content of ores, etc.) metric tons	78,202	115,167	67,325	98,705	69,854	143,268
Gem stones	NA	100	NA	100	NA	100
Gold (recoverable content of ores, etc.) troy ounces	22,348	3,314	19,967	3,865	24,050	7,395
Lead (recoverable content of ores, etc.) metric tons	96	65	132	98	258	299
Lime thousand short tons	223	7,705	204	7,030	216	8,965
Pumice do	5	7	--	--	--	--
Sand and gravel do	4,867	10,421	[4]6,391	[4]14,230	7,012	15,106
Silver (recoverable content of ores, etc.) thousand troy ounces	3,367	15,558	2,918	15,759	3,302	36,618
Stone:						
Crushed thousand short tons	3,680	7,923	3,188	7,733	2,527	7,806
Dimension do	3	114	W	W	W	W
Talc do	226	2,947	319	5,152	343	5,940
Zinc (recoverable content of ores, etc.) metric tons	79	54	79	54	104	86
Combined value of cement, fluorspar (1977), gypsum, iron ore, peat, phosphate rock, sand and gravel (industrial, 1978), tungsten ore, vermiculite, and values indicated by symbol W	XX	45,658	XX	49,375	XX	54,196
Total	XX	213,253	XX	205,800	XX	291,287
NEBRASKA						
Clays thousand short tons	161	368	146	418	156	454
Gem stones	NA	11	NA	W	NA	W
Sand and gravel thousand short tons	[4]16,848	[4]30,566	16,720	31,910	16,197	33,001
Stone (crushed) do	4,128	12,974	4,201	14,758	4,995	19,362
Combined value of cement, sand and gravel, (industrial, 1977), and values indicated by symbol W	XX	34,174	XX	36,287	XX	46,364
Total	XX	78,093	XX	83,373	XX	99,181
NEVADA						
Barite thousand short tons	1,158	18,329	1,788	30,034	1,734	34,320
Cement, portland do	W	W	431	22,163	W	W
Clays do	[3]10	[3]158	51	514	76	1,163
Copper (recoverable content of ores, etc.) metric tons	60,836	89,593	20,453	29,986	[6]123	[6]253
Gem stones	NA	1,000	NA	1,000	NA	1,000
Gold (recoverable content of ores, etc.) troy ounces	324,003	48,053	260,895	50,496	199,960	61,488
Gypsum thousand short tons	1,242	6,834	1,335	7,883	1,075	6,771

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
	NEVADA—Continued					
Lead (recoverable content of ores, etc.) metric tons	674	$456	653	$485	24	$28
Mercury 76-pound flasks	W	W	24,163	3,705	29,368	8,256
Molybdenum pounds	W	W	99,311	469	39826	242
Perlite thousand short tons	W	W	6	75	5	71
Pumice do	656	1,154	706	1,282	W	W
Sand and gravel do	10,185	21,172	[4]10,040	[4]22,620	[4]10,498	[4]21,387
Silver (recoverable content of ores, etc.) thousand troy ounces	738	3,411	804	4,341	529	5,862
Stone (crushed) thousand short tons	1,668	5,506	1,426	5,489	1,602	6,439
Tungsten (W content) thousand pounds	263	1,687	W	W	W	W
Zinc (recoverable content of ores, etc.) metric tons	1,517	1,150	1,371	937	W	W
Combined value of clays (common clay, fuller's earth, and kaolin, 1977), diatomite, fluorspar, iron ore, lime, lithium compounds, magnesite, salt, sand and gravel (industrial, 1978-79), talc, and values indicated by symbol W	XX	65,313	XX	55,930	XX	90,870
Total	XX	263,816	XX	237,409	XX	238,150
	NEW HAMPSHIRE					
Sand and gravel thousand short tons	6,835	13,888	7,859	16,300	7,086	15,301
Stone:						
Crushed do	719	2,036	914	2,634	866	2,172
Dimension do	73	4,650	61	4,077	86	5,774
Combined value of other nonmetals	XX	127	XX	161	XX	11
Total	XX	20,701	XX	23,172	XX	23,258
	NEW JERSEY					
Clays thousand short tons	68	374	68	376	67	559
Gem stones	NA	17	NA	1	NA	1
Lime thousand short tons	W	W	17	787	W	W
Peat do	30	769	24	568	23	549
Sand and gravel do	9,697	29,327	10,430	40,840	10,781	44,682
Stone, crushed[6] do	12,993	46,621	13,192	50,181	13,950	63,174
Zinc (recoverable content of ores, etc.) metric tons	30,358	23,024	28,915	19,761	31,118	25,589
Combined value of iron ore (1977-78), magnesium compounds, marl (greensand), stone (dimension), titanium concentrate (ilmenite), and values indicated by symbol W	XX	16,928	XX	15,342	XX	17,135
Total	XX	117,060	XX	127,856	XX	151,689
	NEW MEXICO					
Clays[2] thousand short tons	69	113	65	108	74	124
Copper (recoverable content of ores, etc.) metric tons	149,411	220,037	127,827	187,405	164,281	336,934
Gem stones	NA	170	NA	180	NA	180
Gold (recoverable content of ores, etc.) troy ounces	13,560	2,011	9,879	1,912	22,976	7,065
Gypsum thousand short tons	182	1,227	263	2,649	251	3,244
Lead (recoverable content of ores, etc.) metric tons	W	W	W	W	43	49
Manganiferous ore (5% to 35% Mn) short tons	29,120	W	36,443	W	33,152	W
Mica (scrap) thousand short tons	14	W	16	W	17	W
Peat do	2	55	2	60	2	40
Perlite do	521	9,543	576	12,510	588	14,874
Potassium salts thousand metric tons	1,891	169,616	1,943	183,554	2,005	228,776
Pumice thousand short tons	457	1,835	631	2,706	604	3,550
Salt do	W	W	180	1,617	W	W
Sand and gravel do	8,604	17,685	8,239	17,850	7,141	18,245
Silver (recoverable content of ores, etc.) thousand troy ounces	918	4,242	W	W	W	W
Stone:						
Crushed thousand short tons	1,950	4,786	2,438	6,157	2,589	6,743
Dimension do	17	106	18	115	20	117
Tin metric tons	--	--	W	W	--	--

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
NEW MEXICO—Continued						
Combined value of barite (1979), carbon dioxide, cement, clays (fire clay), helium (high-purity, 1977-78), lime, molybdenum, vanadium, zinc, and values indicated by symbol W	XX	$65,617	XX	$60,736	XX	$74,507
Total	XX	497,043	XX	477,559	XX	694,448
NEW YORK						
Clays[2] thousand short tons	564	1,728	659	2,121	836	3,027
Gem stones	NA	15	NA	20	NA	20
Lead (recoverable content of ores, etc.) metric tons	2,520	1,706	990	735	458	532
Peat thousand short tons	39	569	49	770	38	630
Salt do	6,452	72,623	5,879	77,236	6,387	77,751
Sand and gravel do	29,197	57,570	[4]28,760	[4]59,280	[4]26,242	[4]55,889
Silver (recoverable content of ores, etc.) thousand troy ounces	56	260	21	113	11	117
Stone:						
Crushed thousand short tons	29,922	88,509	35,748	98,530	36,901	112,362
Dimension do	25	2,272	25	2,586	27	2,626
Zinc (recoverable content of ores, etc.) metric tons	64,264	48,737	26,463	18,086	12,133	9,977
Combined value of cement, clays (ball clay), emery, garnet (abrasive), gypsum, iron ore, lime, sand and gravel (industrial, 1978-79), talc, titanium concentrate (ilmenite), and wollastonite	XX	163,726	XX	159,065	XX	190,779
Total	XX	437,715	XX	418,542	XX	453,710
NORTH CAROLINA						
Clays[2] thousand short tons	3,022	4,990	3,542	9,067	3,308	8,385
Feldspar short tons	509,976	11,410	509,291	11,178	523,663	14,531
Gem stones	NA	75	NA	50	NA	50
Mica, scrap thousand short tons	91	[r]5,071	97	5,729	91	5,892
Sand and gravel do	9,690	21,269	11,446	28,080	11,203	29,733
Stone:						
Crushed thousand short tons	32,810	87,254	37,687	108,867	39,864	125,319
Dimension do	40	3,041	40	3,050	49	3,932
Talc and pyrophyllite do	W	W	W	W	130	692
Combined value of asbestos (1977-78), cement, clays (kaolin), lithium compounds, mica (sheet, 1977-78), olivine, phosphate rock, and values indicated by symbol W	XX	99,265	XX	128,557	XX	153,752
Total	XX	[r]232,375	XX	294,578	XX	342,286
NORTH DAKOTA						
Gem stones	NA	2	NA	1	NA	1
Peat thousand short tons	(3)	W	(3)	W	(3)	W
Sand and gravel do	5,821	12,102	7,407	17,170	6,648	15,128
Combined value of clays, lime, salt, and values indicated by symbol W	XX	4,672	XX	4,966	XX	6,105
Total	XX	16,776	XX	22,137	XX	21,234
OHIO						
Cement:						
Masonry thousand short tons	186	8,875	196	10,955	170	10,869
Portland do	1,970	65,899	2,022	75,637	1,921	87,483
Clays do	3,568	12,835	3,778	15,394	3,374	13,495
Gypsum do	W	W	171	1,375	W	W
Lime do	3,199	111,100	3,467	129,316	3,392	141,663
Peat do	15	107	10	90	8	191
Salt do	3,701	63,485	3,897	74,572	4,135	79,598
Sand and gravel do	46,521	100,736	47,158	112,157	45,944	121,048
Stone:						
Crushed do	44,853	116,409	49,316	130,472	50,717	149,819
Dimension do	147	3,557	90	3,295	50	1,702

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
OHIO—Continued						
Combined value of abrasives, gem stones, and values indicated by symbol W	XX	$1,336	XX	$86	XX	$1,452
Total	XX	484,339	XX	553,349	XX	607,320
OKLAHOMA						
Clays ---------- thousand short tons	1,016	1,687	1,019	1,874	949	1,999
Gypsum ---------- do	1,238	6,959	1,398	8,097	999	5,668
Helium:						
High purity ------ million cubic feet	389	11,507	418	11,771	388	10,801
Crude ---------- do	W	W	68	822	109	1,307
Pumice ---------- thousand short tons	1	W	1	W	1	W
Sand and gravel ---------- do	11,669	26,827	[4]10,850	[4]19,060	12,101	32,502
Stone:						
Crushed ---------- do	23,323	46,809	26,649	57,173	28,312	66,666
Dimension ---------- do	9	634	24	902	38	1,383
Combined value of cement, feldspar, iodine, lead (1977), lime, salt, sand and gravel (industrial, 1978), tripoli, zinc (1977), and values indicated by symbol W	XX	68,217	XX	85,008	XX	80,696
Total	XX	162,640	XX	184,707	XX	201,022
OREGON						
Cement:						
Masonry ------ thousand short tons	W	W	1	75	W	W
Portland ---------- do	W	W	574	29,104	W	W
Clays ---------- do	119	193	140	261	139	263
Copper (recoverable content of ores, etc.) metric tons	5	7	W	W	2	4
Diatomite ------ thousand short tons	3	W	W	W	W	W
Gem stones	NA	520	NA	600	NA	500
Gold (recoverable content of ores, etc.) troy ounces	675	100	340	66	W	W
Lead (recoverable content of ores, etc.) metric tons	--	--	--	--	(3)	(3)
Nickel (content of ores and concentrates) short tons	14,347	W	13,509	W	15,065	W
Pumice ---------- thousand short tons	1,083	2,429	915	2,016	781	1,644
Sand and gravel ---------- do	15,833	33,127	19,130	44,510	17,874	45,829
Silver (recoverable content of ores, etc.) thousand troy ounces	7	33	2	9	2	17
Stone ---------- thousand short tons	[4]17,600	[4]39,400	[4]17,685	[4]39,509	25,739	65,078
Talc and soapstone ---------- short tons	721	151	W	W	W	W
Combined value of lime, stone (dimension, 1977-78), tungsten concentrate (1977), and values indicated by symbol W	XX	33,172	XX	12,693	XX	51,872
Total	XX	109,132	XX	128,843	XX	165,207
PENNSYLVANIA						
Cement:						
Masonry ------ thousand short tons	411	19,927	445	22,803	415	24,177
Portland ---------- do	6,162	196,443	6,750	228,568	6,508	259,756
Clays[2] ---------- do	2,304	13,075	2,571	18,175	2,468	20,099
Gem stones	NA	10	--	--	--	--
Lime ---------- thousand short tons	2,007	72,591	2,126	83,869	2,153	96,569
Mica (scrap) ---------- do	1	W	2	W	4	W
Peat ---------- do	16	353	23	435	24	531
Sand and gravel ---------- do	18,846	52,578	[4]19,140	[4]51,240	20,150	71,740
Stone:						
Crushed ---------- do	63,522	163,652	69,041	194,518	71,730	224,908
Dimension ---------- do	66	5,362	70	5,215	77	5,961
Zinc (recoverable content of ores, etc.) metric tons	20,706	15,703	19,099	13,053	21,447	17,636
Combined value of clays (kaolin), copper (1977), iron ore (1977), sand and gravel (industrial, 1978), tripoli, and values indicated by symbol W	XX	20,002	XX	11,637	XX	1,237
Total	XX	559,696	XX	629,513	XX	722,614

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
RHODE ISLAND						
Sand and gravel ___ thousand short tons__	2,872	$5,059	2,978	$6,176	3,537	$6,737
Stone, crushed ______________ do____	274	1,238	300	1,316	249	1,148
Combined value of other nonmetals ______	XX	2	XX	1	XX	1
Total ____________________	XX	6,299	XX	7,493	XX	7,886
SOUTH CAROLINA						
Cement, portland __ thousand short tons__	W	W	W	W	1,831	79,377
Clays[2] ________________ do____	2,172	18,705	2,358	22,538	2,272	24,492
Gem stones ____________________	NA	4	NA	5	NA	5
Manganiferous ore _ thousand short tons__	20	W	22	W	26	W
Mica (scrap) ______________ do____	43	589	49	782	47	770
Peat ________________ do____	16	W	16	W	W	W
Sand and gravel ______________ do____	7,766	19,281	8,344	22,530	8,321	26,665
Stone:						
Crushed ______________ do____	14,772	36,043	16,997	44,237	16,589	48,352
Dimension ______________ do____	13	627	10	567	9	482
Combined value of cement (masonry), clays (fuller's earth), vermiculite, and values indicated by symbol W ______________	XX	68,952	XX	92,142	XX	21,568
Total ____________________	XX	144,201	XX	182,801	XX	201,711
SOUTH DAKOTA						
Cement:						
Masonry _____ thousand short tons__	W	W	W	W	7	434
Portland ______________ do____	W	W	W	W	670	31,273
Clays ________________ do____	[2]197	[2]233	[2]216	[2]268	205	292
Gem stones ____________________	NA	40	NA	50	NA	50
Gold (recoverable content of ores, etc.) troy ounces__	304,846	45,212	285,512	55,261	245,912	75,618
Mica, scrap ______ thousand short tons__	([3])	5	([3])	4	([3])	2
Sand and gravel ______________ do____	6,043	9,815	6,404	11,100	6,001	10,119
Silver (recoverable content of ores, etc.) thousand troy ounces__	69	317	53	287	58	643
Stone:						
Crushed ______ thousand short tons__	3,377	7,477	3,693	8,376	3,891	10,317
Dimension ______________ do____	35	11,404	36	11,859	36	13,268
Combined value of beryllium concentrate (1977), clays (bentonite, 1977-78), feldspar, gypsum, iron ore (1978-79), lime, and values indicated by symbol W ____________	XX	28,282	XX	27,554	XX	6,670
Total ____________________	XX	102,785	XX	114,759	XX	148,686
TENNESSEE						
Cement:						
Masonry _____ thousand short tons__	195	7,878	217	10,443	170	8,600
Portland ______________ do____	1,522	52,894	1,568	60,223	1,335	57,146
Clays ________________ do____	[3]1,578	[2]13,968	1,760	21,719	1,561	26,071
Copper (recoverable content of ores, etc.) metric tons__	5,613	8,266	11,289	16,550	W	W
Gem stones ____________________	--	--	NA	1	NA	1
Gold (recoverable content of ores, etc.) troy ounces__	13	2	W	W	--	--
Phosphate rock __ thousand metric tons__	1,747	14,253	1,709	14,047	1,873	14,770
Sand and gravel ___ thousand short tons__	12,773	29,197	11,960	28,630	11,210	29,056
Silver (recoverable content of ores, etc.) thousand troy ounces__	60	278	W	W	W	W
Stone:						
Crushed ______ thousand short tons__	41,897	99,196	45,460	117,271	45,718	133,727
Dimension ______________ do____	13	941	12	1,035	12	1,000
Zinc (recoverable content of ores, etc.) metric tons__	82,044	62,221	87,906	60,078	85,119	69,995
Combined value of barite, clays (bentonite and fuller's earth, 1977), lime, pyrites, and values indicated by symbol W ________	XX	14,585	XX	16,845	XX	45,378
Total ____________________	XX	303,679	XX	346,842	XX	385,74

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
TEXAS						
Cement:						
Masonry ----- thousand short tons--	254	$13,095	290	$17,248	268	$15,593
Portland ---------------do----	8,482	331,758	8,808	401,220	9,353	475,836
Clays ---------------do----	[2]3,682	[2]11,465	4,189	19,818	3,871	21,533
Gem stones----------------------	NA	160	NA	170	NA	170
Gypsum-------- thousand short tons--	1,718	8,837	1,864	11,060	1,903	11,438
Helium (high-purity) -- million cubic feet--	--	--	32	1,132	70	2,447
Lime --------- thousand short tons--	1,612	49,965	1,408	48,882	1,507	59,520
Salt ---------------do----	10,941	53,264	9,100	49,153	11,283	67,602
Sand and gravel---------------do----	55,495	133,420	56,925	149,599	52,846	167,076
Stone:						
Crushed---------------do----	65,446	122,784	69,095	150,868	74,612	188,746
Dimension ---------------do----	27	3,922	28	4,192	17	3,636
Sulfur (Frasch) -- thousand metric tons--	3,536	W	3,752	W	4,649	W
Talc and soapstone --------short tons--	223,024	2,191	288,407	1,520	207,398	1,544
Combined value of asphalt (natural), clays (ball clay, fuller's earth, and kaolin, 1977), fluorspar, gold (1978), graphite, helium (crude), iron ore, lead (1978), magnesium chloride, magnesium compounds, silver (1978), sodium sulfate, vermiculite (1977-78), zinc (1978), and values indicated by symbol W -------------------	XX	[r]304,432	XX	299,298	XX	391,027
Total -------------------	XX	[r]1,035,293	XX	1,154,160	XX	1,406,168
UTAH						
Clays --------- thousand short tons--	[2]244	[2]713	265	913	355	1,246
Copper (recoverable content of ores, etc.) metric tons--	176,111	259,357	186,329	273,175	193,082	396,003
Gem stones----------------------	NA	100	NA	75	NA	75
Gold (recoverable content of ores, etc.) troy ounces--	210,501	31,219	235,929	45,664	260,916	80,232
Gypsum-------- thousand short tons--	324	2,510	316	2,777	772	6,552
Iron ore (usable), thousand long tons, gross weight--	1,932	19,780	1,961	21,224	1,618	19,391
Lead (recoverable content of ores, etc.) metric tons--	9,749	6,598	2,541	1,888	W	W
Lime --------- thousand short tons--	209	8,274	225	7,196	198	8,250
Pumice ---------------do----	W	W	28	270	28	280
Salt ---------------do----	843	10,831	956	13,532	1,204	14,723
Sand and gravel[4] ------------do----	11,895	18,662	12,580	21,840	10,363	18,621
Silver (recoverable content of ores, etc.) thousand troy ounces--	3,283	15,160	2,885	15,579	2,454	27,216
Stone:						
Crushed------ thousand short tons--	2,765	7,072	2,817	9,716	3,424	11,059
Dimension ---------------do----	6	238	7	264	5	216
Tungsten --------- thousand pounds--	27	219	11	80	W	W
Zinc (recoverable content of ores, etc.) metric tons--	16,111	12,218	3,509	2,398	W	W
Combined value of asphalt, beryllium concentrate, carbon dioxide (natural), cement, clays (kaolin and fuller's earth, 1977), magnesium compounds, molybdenum, perlite (1979), phosphate rock, potassium salts, sand and gravel (industrial), sodium sulfate, vanadium, and values indicated by symbol W -------------------	XX	104,260	XX	136,041	XX	169,520
Total -------------------	XX	497,220	XX	552,632	XX	753,384
VERMONT						
Sand and gravel--- thousand short tons--	3,405	5,837	3,726	6,425	3,660	6,240
Stone:						
Crushed---------------do----	2,123	12,635	1,971	13,178	2,077	13,927
Dimension ---------------do----	121	14,561	137	17,681	180	23,006
Talc ---------------do----	310	2,006	315	2,238	346	2,755
Combined value of other nonmetals ------	XX	6,415	XX	8,311	XX	8,208
Total -------------------	XX	41,454	XX	47,833	XX	54,136

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
VIRGINIA						
Clays thousand short tons	890	$1,294	1,043	$3,266	1,059	$3,512
Gem stones	NA	12	NA	15	NA	15
Lead (recoverable content of ores, etc.) metric tons	1,999	1,352	1,803	1,339	1,596	1,852
Lime thousand short tons	846	28,767	832	30,578	872	34,935
Sand and gravel[4] do	10,447	24,605	11,430	29,070	11,803	32,268
Stone:						
Crushed do	41,707	109,737	50,442	141,601	51,080	165,223
Dimension do	10	1,864	10	1,943	9	2,042
Zinc (recoverable content of ores, etc.) metric tons	12,040	9,131	10,974	7,500	11,406	9,380
Combined value of aplite, cement, gypsum, kyanite, sand and gravel (industrial), silver (1977), talc (soapstone), and vermiculite (1979)	XX	39,104	XX	49,585	XX	60,538
Total	XX	215,866	XX	264,897	XX	309,765
WASHINGTON						
Cement:						
Masonry thousand short tons	W	W	W	W	10	741
Portland do	1,462	65,281	1,760	86,671	1,761	98,659
Clays[2] do	309	1,091	357	1,418	339	1,549
Gem stones	NA	160	NA	170	NA	170
Gold (recoverable content of ores, etc.) troy ounces	24,006	3,560	W	W	W	W
Lead (recoverable content of ores, etc.) metric tons	1,090	738	W	W	W	W
Peat thousand short tons	12	117	10	124	11	148
Pumice do	W	W	50	63	--	--
Sand and gravel do	18,505	39,124	[4]22,150	[4]49,440	[4]24,258	[4]59,382
Silver (recoverable content of ores, etc.) thousand troy ounces	121	557	W	W	W	W
Stone:						
Crushed thousand short tons	12,239	28,156	9,789	22,059	15,192	35,783
Dimension do	5	440	5	454	4	268
Zinc (recoverable content of ores, etc.) metric tons	5,055	3,834	W	W	--	--
Combined value of clays (fire clay), copper, diatomite, gypsum, lime, olivine, sand and gravel (industrial, 1978-79), talc (1977-78), tungsten, and values indicated by symbol W	XX	[r]9,829	XX	20,034	XX	28,248
Total	XX	[r]152,887	XX	180,433	XX	224,948
WEST VIRGINIA						
Clays[2] thousand short tons	389	599	343	575	330	592
Gem stones	NA	2	--	--	--	--
Salt thousand short tons	1,048	W	1,030	W	1,078	W
Sand and gravel[4] do	3,891	10,402	3,264	13,050	4,138	18,501
Stone do	10,495	28,022	11,582	32,897	11,713	37,624
Combined value of cement, clays (fire clay), lime, sand and gravel (industrial), stone (dimension), and values indicated by symbol W	XX	47,569	XX	56,996	XX	61,878
Total	XX	86,594	XX	103,518	XX	118,595
WISCONSIN						
Gem stones	NA	1	--	--	--	--
Iron ore (usable), thousand long tons, gross weight	668	W	W	W	736	W
Lime thousand short tons	378	13,521	430	17,301	429	19,060
Peat do	14	196	12	201	11	720
Sand and gravel do	29,025	50,210	30,470	53,010	32,046	58,576
Stone:						
Crushed do	22,241	42,097	24,385	46,990	23,924	52,804
Dimension do	73	4,821	64	4,562	54	4,204
Combined value of abrasive stone, cement, clays, lead, zinc, and values indicated by symbol W	XX	39,282	XX	37,162	XX	44,318
Total	XX	150,128	XX	159,226	XX	179,682

See footnotes at end of table.

Table 6.—Nonfuel mineral production[1] in the United States, by State —Continued

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
WYOMING						
Clays ---------- thousand short tons--	2,966	$48,369	3,632	$66,975	3,471	$75,096
Gem stones------------------------	NA	200	NA	200	NA	200
Gypsum-------- thousand short tons--	356	2,571	370	2,995	366	3,100
Pumice --------------------do----	--	--	7	W	--	--
Sand and gravel--------------do----	5,084	11,026	5,101	11,240	[4]5,265	[4]11,419
Stone --------------------do----	[6]2,434	[6]7,585	[6]2,661	[6]8,037	5,013	15,634
Combined value of cement, feldspar, iron ore, lime, phosphate rock, sand and gravel (industrial, 1979), sodium carbonate (natural), stone (dimension, 1977-78), and values indicated by symbol W ----------------	XX	372,693	XX	403,622	XX	484,727
Total ----------------------	XX	442,444	XX	493,069	XX	590,176

[r] Revised. NA Not available. W Withheld to avoid disclosing company proprietary data. XX Not applicable.

[1] Production as measured by mine shipments sales, or marketable production (including consumption by producers).

[2] Excludes certain clays; value included with "Combined value" figure.

[3] Less than 1/2 unit.

[4] Excludes industrial sand and gravel; value included with "Combined value" figure.

[5] Total of items listed.

[6] Excludes certain stones; value included with "Combined value" figure.

[7] Excludes salt in brines; value included with "Combined value" figure.

[8] Incomplete data.

Table 7.—Mineral production[1] in the islands administered by the United States

(Thousand short tons and thousand dollars)

Area and mineral	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
American Samoa:						
Pumice	1	10	4	24	2	15
Stone	6	31	5	27	W	W
Total	XX	41	XX	51	XX	15
Guam: Stone	577	1,807	824	3,433	669	2,483
Virgin Islands: Stone	--	--	258	1,816	W	2,828

W Withheld to avoid disclosing company proprietary data. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 8.—Mineral production[1] in the Commonwealth of Puerto Rico

(Thousand short tons and thousand dollars)

Mineral	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement	1,367	67,775	1,442	78,981	1,406	70,197
Clays	272	387	286	544	260	556
Lime	40	3,007	41	3,249	37	3,307
Salt	27	639	27	639	27	639
Sand and gravel	[e]12,000	[e]21,000	NA	NA	NA	NA
Stone	405	3,709	13,908	49,509	14,826	60,838
Total	XX	96,517	XX	[2]132,922	XX	[2]135,537

[e] Estimate. NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Total does not include value of items withheld or not available.

Table 9.—U.S. exports of principal minerals and products, excluding mineral fuels

Mineral	1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS				
Aluminum:				
Ingots, slabs, crude short tons	126,617	$134,483	200,650	$264,296
Scrap do	194,508	140,756	307,080	290,316
Plates, sheets, bars, etc do	186,895	321,557	248,027	501,850
Castings and forgings do	NA	88,445	7,404	35,671
Aluminum sulfate metric tons	21,000	2,117	24,000	2,706
Other aluminum compounds do	27,000	19,300	36,000	28,000
Antimony, metals and alloys, crude short tons	556	358	485	675
Bauxite, including bauxite concentrate thousand metric tons	23	2,800	24	4,700
Beryllium pounds	81,679	1,985	72,152	3,686
Bismuth, metals and alloys do	96,346	457	427,809	1,408
Cadmium metric tons	326	864	211	550
Chromium:				
Ore and concentrate:				
Exports thousand short tons	23	2,767	27	2,514
Reëxports do	29	2,574	28	2,860
Ferrochromium do	19	10,727	15	14,558
Cobalt thousand pounds	1,548	17,848	726	17,845
Columbium metals, alloys, other forms do	NA	NA	NA	NA
Copper:				
Ore, concentrate, composition metal, and unrefined (copper content) metric tons	36,848	38,999	57,225	85,085
Scrap do	49,076	54,445	54,080	70,624
Refined copper and semimanufactures do	185,041	450,936	173,006	486,053
Other copper manufactures do	8,594	14,654	19,460	40,462
Ferroalloys not elsewhere listed:				
Ferrophosphorus do	4,168	696	37,292	3,678
Ferroalloys, n.e.c do	13,937	9,356	6,441	12,616
Gold:				
Ore and base bullion troy ounces	485,019	88,882	901,527	287,361
Bullion, refined do	5,024,471	1,024,912	15,589,872	4,620,503
Iron ore thousand long tons	4,213	136,721	5,148	178,749
Iron and steel:				
Pig iron short tons	51,116	4,470	105,116	10,058
Iron and steel products (major):				
Steel mill products do	2,421,678	1,328,734	2,817,943	1,878,437
Other steel products do	416,958	626,087	377,183	714,398
Iron and steel scrap:				
Ferrous scrap, including rerolling materials thousand short tons	9,090	703,996	11,197	1,158,064
Lead and zinc ores and concentrates metric tons	54,231	9,916	32,902	19,677
Lead:				
Pigs, bars, anodes, sheets, etc do	8,225	17,485	10,646	13,928
Scrap do	98,633	27,654	119,748	53,514
Magnesium, metal and alloys, scrap, semimanufactured forms, n.e.c short tons	41,807	75,787	54,280	113,828
Manganese:				
Ore and concentrate do	200,128	13,123	58,323	5,698
Ferromanganese do	9,433	4,769	25,344	19,252
Silicomanganese do	4,782	1,568	5,243	2,627
Metal do	6,138	5,165	6,634	7,463
Mercury:				
Exports 76-pound flasks	NA	NA	NA	NA
Reexports do	NA	NA	NA	NA
Molybdenum:				
Ore and concentrate (molybdenum content) thousand pounds	69,150	328,294	72,242	658,882
Metals and alloys, crude and scrap do	389	1,549	1,142	9,997
Wire do	495	6,603	664	11,022
Semimanufactured forms, n.e.c do	248	3,815	289	5,548
Powder do	622	2,893	296	2,982
Ferromolybdenum do	1,466	6,721	1,681	10,030
Compounds do	3,004	10,587	10,293	110,163
Nickel:				
Alloys and scrap (including unwrought metal, ingots, bars, sheets, anodes, etc.) short tons	22,487	109,678	38,570	220,943
Catalysts do	4,995	16,941	5,197	19,993
Nickel-chrome electric resistance wire do	804	6,197	.733	7,993
Semifabricated forms, n.e.c do	8,007	50,434	6,310	48,304
Platinum-group metals:				
Ore and scrap troy ounces	179,462	23,082	189,218	47,394
Palladium, rhodium, iridium, osmiridium, ruthenium, and osmium (metal and alloys including scrap) do	356,990	36,507	502,548	77,810
Platinum (metal and alloy) do	166,095	42,477	207,832	76,953
Rare earths:				
Ferrocerium and alloys short tons	19	214	42	273
Compounds pounds	NA	NA	NA	NA
Selenium thousand pounds	227	1,579	333	3,870
Silicon:				
Ferrosilicon short tons	11,900	7,871	22,357	14,740
Silicon carbide, crude and in grains do				

See footnotes at end of table.

Table 9.—U.S. exports of principal minerals and products, excluding mineral fuels —Continued

Mineral	1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS —Continued				
Silver:				
Ore, concentrate, waste, sweepings thousand troy ounces	12,411	$64,531	19,231	$233,620
Bullion, refined do	9,989	54,594	16,332	237,542
Tantalum:				
Ore, metal, other forms thousands pounds	750	18,637	656	35,679
Powder do	211	11,033	296	26,060
Tin:				
Ingots, pigs, bars, etc.:				
Exports metric tons	498	5,926	568	8,074
Reexports do	4,194	51,901	2,849	42,783
Tin scrap and other tin-bearing material except tinplate scrap do	339,529	142,389	399,525	204,986
Titanium:				
Ore and concentrate short tons	NA	NA	9,908	2,057
Unwrought and scrap metal do	5,760	10,269	5,302	20,409
Intermediate mill shapes and mill products, n.e.c do	2,029	23,058	3,300	52,368
Pigments and oxides do	39,341	29,472	51,456	48,151
Tungsten (tungsten content):				
Ore and concentrate thousand pounds	1,853	12,555	1,929	12,909
Carbide powder do	1,453	13,788	1,392	22,096
Alloy powder do	716	10,409	662	10,907
Vanadium:				
Ore and concentrate (vanadium content) pounds	382,000	1,570	201,000	824
Vanadium pentoxide, etc do	3,059,000	5,363	1,891,000	5,139
Ferrovanadium do	2,617,000	9,986	1,759,000	7,881
Zinc:				
Slabs, pigs, or blocks metric tons	723	865	279	553
Sheets, plates, strips, other forms n.e.c do	2,262	3,414	1,824	3,385
Waste, scrap, and dust (zinc content) do	16,789	8,756	29,115	15,592
Semifabricated forms, n.e.c do	1,414	1,789	1,827	2,671
Zirconium:				
Ore and concentrate thousand pounds	15,343	2,237	17,712	2,589
Oxide do	4,251	4,143	2,981	3,384
Metals, alloys, other forms do	2,060	34,855	1,853	33,912
NONMETALS				
Abrasives:				
Dust and powder of precious or semiprecious stones, including diamond dust and powder thousand carats	19,481	51,104	27,769	72,816
Crushing bort do	--	--	--	--
Industrial diamonds do	2,955	40,329	2,738	47,325
Diamond grinding wheels do	718	5,955	589	6,638
Other natural and artificial metallic abrasives and products	NA	82,287	NA	151,746
Asbestos:				
Exports:				
Unmanufactured short tons	48,954	20,227	71,692	19,934
Products do	NA	63,050	NA	128,163
Reexports:				
Unmanufactured do	1,076	374	939	851
Products do	NA	347	NA	2,723
Barite:				
Natural barium sulfate and carbonate do	38,694	2,724	108,841	10,861
Boron:				
Boric acid do	46,319	22,217	41,956	22,938
Sodium borates, refined do	303,942	e80,000	332,308	e94,000
Calcium:				
Carbonate do	22,519	10,139	20,417	11,874
Chloride do	45,099	4,539	30,307	5,723
Dicalcium phosphate do	129,532	19,452	559,963	24,114
Cement do	57,817	8,950	150,846	14,572
Clays:				
Kaolin or china clay thousand short tons	1,174	95,370	1,583	125,946
Bentonite do	723	43,252	853	55,252
Other clays do	768	56,292	769	62,524
Diatomite do	153	21,463	170	26,496
Feldspar, leucite, nepheline syenite thousand pounds	20,662	853	24,572	1,025
Fluorspar short tons	8,267	978	14,454	1,339
Gem stones:				
Diamonds thousand carats	1,599	736,700	1,196	884,600
Pearls	NA	5,100	NA	800
Other	NA	41,600	NA	54,600
Graphite short tons	9,595	2,304	8,623	3,741
Gypsum:				
Crude, crushed or calcined thousand short tons	132	8,752	91	10,891
Manufactures, n.e.c	NA	11,052	NA	11,497
Helium million cubic feet	190	10,431	e245	10,607
Lithium hydroxide thousand pounds	4,081	5,117	5,798	7,728
Kyanite and allied minerals short tons	NA	NA	NA	NA
Lime do	44,794	3,082	45,421	3,827

See footnotes at end of table.

Table 9.—U.S. exports of principal minerals and products, excluding mineral fuels —Continued

Mineral	1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)
NONMETALS —Continued				
Magnesium compounds:				
Magnesite, dead-burned short tons	61,004	$10,617	33,035	$8,183
Magnesite, crude, caustic calcined, lump or ground do	46,353	7,741	68,375	16,433
Mica sheet, waste and scrap, and ground do	9,262	3,255	11,673	3,047
Mica, manufactured pounds	NA	4,697	NA	5,224
Mineral-earth pigments, iron oxide, natural and synthetic short tons	7,064	6,649	4,852	7,359
Nitrogen compounds (major) thousand short tons	8,239	879,279	9,218	1,171,494
Phosphate rock thousand metric tons	13,693	366,795	14,787	431,981
Phosphatic fertilizers:				
Superphosphates do	1,494	145,703	1,469	188,898
Ammonium phosphates do	4,388	579,838	4,474	746,576
Elemental phosphorus short tons	20,580	23,920	29,604	35,675
Mixed chemical fertilizers thousand metric tons	199	23,176	NA	69,152
Pigments and compounds (lead and zinc):				
Zinc compounds metric tons	NA	NA	NA	NA
Potash:				
Potassium chloride do	1,126,000	68,100	891,200	66,050
Potassium sulfate do	305,000	20,500	227,800	13,410
Pumice and pumicite short tons	[e]2,000	NA	[e]2,000	NA
Quartz, natural, quartzite do	NA	NA	NA	NA
Salt:				
Crude and refined thousand short tons	776	9,795	[e]793	9,489
Shipments to noncontiguous territories do	20	3,409	21	3,924
Sand and gravel:				
Sand:				
Construction do	800	5,100	324	3,800
Industrial do	2,800	22,600	1,200	27,500
Gravel do	625	1,600	566	1,200
Sodium compounds:				
Sodium sulfate short tons	84	5,475	102	8,516
Sodium carbonate do	779	61,454	997	86,663
Stone:				
Dolomite, block thousand short tons	38	216	16	157
Limestone, crushed, ground, broken short tons	3,600	12,524	3,931	16,060
Marble and other building and monumental do	NA	8,371	NA	11,706
Stone, crushed, ground, broken thousand short tons	409	6,454	321	7,835
Manufactures of stone do	NA	5,494	NA	4,826
Sulfur:				
Crude thousand metric tons	827	34,667	1,963	142,966
Talc, crude and ground short tons	267	12,359	316	15,210
Total	XX	10,346,203	XX	18,292,663

[e]Estimate. NA Not available. XX Not applicable.

Table 10.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels

Mineral	1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS				
Aluminum:				
Metal ... short tons	757,092	$745,255	570,634	$645,769
Scrap ... do	92,153	68,056	68,316	59,430
Plates, sheets, bars, etc ... do	230,508	331,708	201,016	343,310
Aluminum oxide (alumina) ... metric tons	3,967,000	589,812	3,837,000	620,422
Antimony:				
Ore (antimony content) ... short tons	4,495	6,174	7,732	11,860
Needle or liquated ... do	52	121	28	90
Metal ... do	4,127	7,897	3,022	7,100
Oxide ... do	10,667	18,803	13,679	17,921
Arsenic:				
White (As_2O_3 content) ... do	10,306	3,770	12,325	5,562
Metallic ... do	369	1,622	405	1,881
Bauxite, crude ... thousand metric tons	13,847	NA	13,780	NA
Beryllium ore ... short tons	1,031	417	1,037	488
Bismuth metal and alloys, gross weight ... pounds	2,657,763	8,310	2,167,278	5,418
Cadmium:				
Metal ... metric tons	2,881	12,861	2,572	13,840
Calcium:				
Metal ... pounds	523,835	825	717,726	1,015
Chloride ... short tons	42,523	2,102	58,091	3,018
Cesium compounds ... pounds	13,307	599	23,182	928
Chromium:				
Ore and concentrate (Cr_2O_3 content) thousand short tons	415	51,434	416	55,604
Ferrochromium (gross weight) ... do	327	113,532	242	116,591
Ferrochromium-silicon ... do	1	51	(2)	21
Metal ... do	4	16,650	4	19,939
Cobalt:				
Metal ... thousand pounds	16,488	167,662	18,887	462,250
Oxide (gross weight) ... do	1,077	9,190	505	9,429
Salts and compounds (gross weight) ... do	696	2,003	370	2,192
Columbium ore ... do	4,279	9,631	3,564	13,083
Copper (copper content):				
Ore and concentrate ... metric tons	22,196	25,483	30,416	48,146
Matte ... do	2,973	4,093	414	543
Blister ... do	82,450	100,929	24,701	39,709
Refined in ingots, etc ... do	402,674	511,944	387,570	388,640
Scrap ... do	21,385	23,970	22,198	33,805
Ferroalloys not elsewhere listed ... short tons	4,586	20,401	6,521	28,749
Gallium ... kilograms	3,721	1,545	6,401	2,672
Germanium ... do	2,656	1,134	4,029	1,296
Gold (general imports):				
Ore and base bullion ... troy ounces	242,747	45,301	255,896	79,534
Bullion ... do	4,446,978	857,723	4,373,802	1,400,669
Hafnium ... pounds	--	--	116	5
Indium ... thousand troy ounces	206	2,085	294	3,779
Iron ore ... thousand long tons	33,616	845,036	33,776	923,426
Iron and steel:				
Pig iron ... short tons	655,412	72,234	476,342	63,251
Iron and steel products (major):				
Steel mill products ... do	21,133,958	6,916,061	17,518,101	6,966,656
Other products ... do	796,723	679,918	787,417	776,928
Scrap (including tinplate) ... thousand short tons	794	50,220	760	70,804
Lead:				
Ore flue dust, matte (lead content) ... metric tons	61,938	25,220	44,401	33,026
Base bullion (lead content) ... do	4,307	2,930	1,681	1,691
Pigs and bars (lead content) ... do	225,405	169,866	182,550	209,451
Reclaimed scrap, etc. (lead content) ... do	3,307	2,878	4,006	3,782
Sheet, pipe, shot ... do	1,438	2,116	215	328
Magnesium:				
Metallic and scrap ... short tons	6,069	7,168	4,217	6,085
Alloys (magnesium content) ... do	542	1,897	412	1,767
Sheets, tubing, ribbons, wire, other forms (magnesium content) ... do	57	1,013	125	1,190
Manganese:				
Ore (35% or more contained manganese) ... do	547,820	33,581	499,782	27,485
Ferromanganese ... do	680,399	177,845	821,213	254,843
Silicomanganese ... do	94,644	26,453	94,671	34,756
Metal ... do	9,113	7,857	6,683	5,545
Mercury:				
Compounds ... pounds	73,711	393	109,515	489
Metal ... 76-pound flasks	41,693	5,240	26,448	5,207
Molybdenum:				
Ore (content) ... thousand pounds	2,705	15,853	2,329	26,211
Waste and scrap ... do	243	1,253	336	5,596
Metal:				
Unwrought (molybdenum content) ... do	181	1,113	85	1,566
Wrought (gross weight) ... do	119	1,931	104	2,305
Ferromolybdenum ... do	364	1,499	62	636

See footnotes at end of table.

Table 10.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels —Continued

Mineral	1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)
METALS —Continued				
Molybdenum —Continued				
Material in chief value molybdenum thousand pounds	1,541	$6,760	690	$12,060
Compounds do	1,670	4,060	2,326	20,334
Nickel:				
Ore short tons	--	--	4,977	12
Pigs, ingots, shot, cathodes do	147,644	582,776	113,280	510,535
Plates, bars, etc do	3,721	26,943	5,376	46,507
Slurry do	69,129	141,110	60,865	122,087
Scrap do	3,694	10,117	3,596	16,634
Powder and flakes do	16,981	70,437	14,177	70,203
Ferronickel do	74,860	74,724	62,593	91,340
Oxide do	6,105	18,897	1,820	8,079
Platinum-group metals:				
Unwrought:				
Grains and nuggets (platinum) troy ounces	26,063	5,229	8,232	3,074
Sponge (platinum) do	1,095,519	257,254	1,352,054	482,206
Sweepings, waste, scrap do	188,392	17,397	156,674	38,199
Iridium do	35,936	7,133	33,166	8,617
Palladium do	1,156,424	75,147	1,435,808	160,048
Rhodium do	94,749	43,654	104,337	73,575
Ruthenium do	73,518	3,544	124,887	5,786
Other platinum-group metals do	106,097	21,753	103,640	33,801
Semimanufactured:				
Platinum do	52,633	12,241	73,925	26,638
Palladium do	67,669	4,898	68,626	8,482
Rhodium do	8,189	734	4,681	1,266
Other platinum-group metals do	16,222	1,167	13,098	345
Radium: Radioactive substitutes	NA	21,563	NA	20,106
Rare-earth metals:				
Ferrocerium, other cerium alloys short tons	65	641	62	680
Monazite do	7,654	1,602	6,931	1,677
Metals, including scandium and yttrium pounds	12,629	260	8,974	186
Rhenium:				
Metal, including scrap do	449	168	927	608
Ammonium perrhenate do	12,042	2,401	8,299	3,259
Selenium and selenium compounds do	799,853	11,745	683,903	11,123
Silicon:				
Metal (over 96% silicon content) short tons	35,527	35,116	27,642	47,702
Ferrosilicon do	135,620	49,881	113,553	57,621
Silver:				
Ore and base bullion thousand troy ounces	9,662	45,535	9,928	83,266
Bullion do	61,359	323,404	78,372	840,731
Sweepings, waste, dore do	4,620	20,077	4,081	37,764
Tantalum ore thousand pounds	1,429	11,358	1,532	30,135
Tellurium pounds	173,989	3,439	167,760	3,189
Thallium do	587	23	949	31
Tin:				
Ore (tin content) metric tons	3,873	43,511	4,529	54,018
Blocks, pigs, grains, etc do	NA	NA	NA	NA
Dross, skimmings, scrap, residue and tin alloys, n.s.p.f do	709	5,365	1,350	11,011
Tinfoil, powder, flitters, etc	NA	32,276	NA	16,732
Tin scrap, and other tin bearing material excluding tinplate scrap	NA	11,232	NA	12,513
Tin compounds metric tons	240	2,472	202	2,473
Titanium:				
Ilmenite[2] short tons	457,843	19,324	295,688	13,946
Rutile do	289,617	53,874	283,479	49,559
Metal do	6,951	25,952	9,908	49,850
Ferrotitanium and ferrosilicon titanium do	863	1,415	964	2,701
Pigments do	117,708	90,741	104,968	88,310
Tungsten (tungsten content):				
Ore and concentrate thousand pounds	9,138	67,733	11,352	84,661
Vanadium (content):				
Ferrovanadium do	782	4,086	1,033	5,967
Vanadium pentoxide do	1,478	4,424	1,814	7,306
Vanadium-bearing materials do	4,468	7,514	4,883	9,000
Zinc:				
Ore (zinc content) metric tons	106,315	37,170	87,499	37,104
Blocks, pigs, slabs do	622,470	386,082	524,130	390,599
Sheets, etc do	337	305	244	267
Fume (zinc content) do	60	10	28	2
Waste and scrap do	3,310	1,250	3,259	1,530
Old, dross, skimmings do	7,436	2,104	4,454	1,735
Dust, powder, flakes do	8,978	7,455	3,586	3,440
Manufactures	NA	462	NA	214
Zirconium:				
Ore, including zirconium sand short tons	91,009	15,209	110,842	16,963
Metal, scrap, compounds do	2,064	16,923	2,078	25,955

See footnotes at end of table.

Table 10.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels —Continued

Mineral	1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)
NONMETALS				
Abrasives:				
Diamonds (industrial) thousand carats	22,183	$87,761	25,325	$110,934
Other abrasives	NA	143,959	NA	159,622
Asbestos short tons	628,333	161,875	565,572	135,210
Barite:				
Crude and ground thousand short tons	1,312	42,214	1,515	66,287
Witherite short tons	1,809	387	441	106
Chemicals do	32,158	10,704	35,291	11,891
Boron:				
Boric acid do	16,277	8,921	7,704	4,267
Calcium borate, crude do	94,053	9,320	81,228	10,946
Cement thousand short tons	6,597	190,643	9,412	302,359
Clays short tons	24,771	2,082	51,198	3,972
Cryolite do	19,452	9,660	13,692	7,195
Feldspar:				
Crude do	39	3	49	6
Ground and crushed do	(1)	(1)	217	25
Fluorspar do	916,705	67,569	1,021,085	80,090
Gem stones:				
Diamond thousand carats	5,656	1,961,558	4,467	1,859,095
Emeralds do	1,643	82,237	2,277	105,064
Other	NA	177,716	NA	206,745
Graphite short tons	99,991	11,700	86,185	13,035
Gypsum:				
Crude, ground, calcined thousand short tons	8,311	33,391	7,775	34,289
Manufactures	NA	30,491	NA	30,790
Iodine, crude thousand pounds	6,837	14,633	6,201	18,454
Kyanite short tons	NA	NA	NA	NA
Lime:				
Hydrated do	62,290	2,491	85,169	3,450
Other do	547,830	16,663	554,332	19,165
Lithium:				
Ore do	--	--	4,390	455
Compounds do	16	338	28	2,040
Magnesium compounds:				
Crude magnesite do	52	3	109	5
Lump, ground, caustic-calcined magnesia do	7,224	793	6,485	1,169
Refractory magnesia, dead-burned, fused magnesite, dead-burned dolomite do	87,461	16,131	92,927	18,580
Compounds do	37,020	4,703	36,439	5,619
Mica:				
Uncut sheet and punch thousand pounds	8,855	2,629	10,587	3,147
Scrap do	1,221	59	176	9
Manufactures do	969	3,096	776	2,929
Mineral-earth pigments, iron oxide pigments:				
Ocher, crude and refined short tons	2	(1)	3	2
Siennas, crude and refined do	796	237	465	210
Umber, crude and refined do	9,363	964	7,567	857
Vandyke brown do	951	282	798	259
Other natural and refined do	1,424	310	1,424	470
Synthetic do	58,013	22,912	45,121	22,543
Nepheline syenite:				
Crude do	178	4	2,260	28
Ground, crushed, etc do	547,845	10,442	533,700	10,818
Nitrogen compounds (major), including urea thousand short tons	5,032	495,905	4,737	467,766
Peat:				
Fertilizer grade short tons	372,784	36,706	372,530	38,807
Poultry and stable grade do	7,526	834	8,033	1,176
Phosphate, crude metric tons	908	24,378	886	21,595
Phosphatic materials:				
Fertilizer and fertilizer materials thousand metric tons	7	1,031	21	3,014
Ammonium phosphates used as fertilizers do	295	36,409	313	42,356
Elemental phosphorus do	(1)	968	(1)	1,264
Other phosphatic materials do	111	12,224	142	16,396
Pigments and salts:				
Lead pigments and compounds metric tons	23,044	17,292	19,718	24,377
Zinc pigments and compounds do	33,569	22,248	87,071	50,617
Potash do	7,761,000	399,000	8,505,000	520,000
Pumice:				
Crude or unmanufactured short tons	3,418	112	3,568	163
Wholly or partly manufactured do	951	88	869	83
Manufactured, n.s.p.f	NA	72	NA	123
Quartz crystal (Brazilian pebble) thousand pounds	165	459	428	216
Salt thousand short tons	5,380	34,247	5,275	40,860
Sand and gravel:				
Industrial sand do	46	1,098	71	752
Other sand and gravel do	579	987	352	428

See footnotes at end of table.

Table 10.—U.S. imports for consumption of principal minerals and products, excluding mineral fuels —Continued

Mineral	1978 Quantity	1978 Value (thousands)	1979 Quantity	1979 Value (thousands)
NONMETALS —Continued				
Sodium compounds:				
Sodium bicarbonate thousand short tons	7	$774	3	$616
Sodium carbonate do.	8	734	40	4,294
Sodium sulfate do.	136	6,590	187	9,486
Stone and whiting	NA	65,966	NA	81,810
Strontium:				
Mineral short tons	41,289	1,885	43,956	2,335
Compounds do.	4,133	2,134	5,861	2,928
Sulfur and compounds, sulfur ore and other forms, n.e.s thousand metric tons	2,177	75,671	2,494	94,147
Talc, unmanufactured short tons	19	2	22	3
Total	XX	19,929,054	XX	22,309,239

NA Not available. XX Not applicable.

[1] Less than 1/2 unit.

[2] Includes titanium slag averaging about 70% TiO_2, for detail see Titanium chapter.

Table 11.—Comparison of world and U.S. production of selected nonfuel mineral commodities

(Thousand short tons unless otherwise specified)

Mineral	1978			1979[p]		
	World production[1]	U.S. production	U.S. percent of world production	World production[1]	U.S. production	U.S. percent of world production
METALS, MINE BASIS						
Antimony (content of ore and concentrate) short tons	72,122	W	W	79,381	W	W
Arsenic, white do.	35,913	W	NA	36,190	W	NA
Bauxite thousand metric tons	81,029	[2]1,669	2	87,813	[2]1,821	2
Beryl short tons	3,094	W	NA	3,082	W	NA
Bismuth thousand pounds	9,745	W	NA	9,422	W	NA
Chromite	10,053	--	--	10,561	--	--
Cobalt (content of ore and concentrate) short tons	27,831	--	--	31,437	--	--
Columbium-tantalum concentrate[3] thousand pounds	51,942	--	--	55,331	--	--
Copper (content of ore and concentrate) thousand metric tons	7.557	1,358	18	7,607	1,444	19
Gold (content of ore and concentrate) thousand troy ounces	39,304	999	3	39,238	920	2
Iron ore thousand long tons	841,027	81,583	10	886,760	85,716	10
Lead (content of ore and concentrate) thousand metric tons	3,494	530	15	3,513	526	15
Manganese ore (35% or more Mn)	24,622	--	NA	26,963	--	--
Mercury thousand 76-pound flasks	184	24	13	194	30	15
Molybdenum (content of ore and concentrate) thousand pounds	220,922	131,843	60	227,097	143,967	63
Nickel (content of ore and concentrate)	729	14	2	776	14	2
Platinum-group metals thousand troy ounces	6,332	8	(4)	6,660	7	(4)
Silver (content of ore and concentrate) do.	344,657	39,385	11	344,457	38,055	11
Tin (content of ore and concentrate) metric tons	251,183	W	NA	256,002	W	NA
Titanium concentrates:						
Ilmenite	3,861	590	15	3,849	639	17
Rutile[3]	332	W	NA	398	W	NA
Tungsten concentrate (contained tungsten) thousand pounds	100,106	6,901	7	100,314	6,600	7
Vanadium (content of ore and concentrate) short tons	35,151	5,204	15	41,420	5,520	13
Zinc (content of ore and concentrate) thousand metric tons	5,878	303	5	5,998	267	5
METALS, SMELTER BASIS						
Aluminum	15,510	4,804	31	15,923	5,023	32
Cadmium metric tons	16,765	1,653	10	18,260	1,715	9
Cobalt	24,734	322	1	28,321	464	2
Copper smelter (primary and secondary)[5] thousand metric tons	7,924	1,343	17	8,036	1,396	17
Iron, pig	558,352	87,690	16	581,696	86,975	15
Lead, smelter (primary and secondary)[6] thousand metric tons	5,342	1,334	25	5,437	1,377	25
Magnesium	312	149	48	335	162	48
Nickel[7]	695	37	5	720	41	6
Selenium[3] thousand pounds	3,193	509	16	3,444	587	17
Steel, raw[8]	783,415	137,031	18	813,927	136,341	17
Tellurium[3] thousand pounds	345	W	NA	459	W	NA
Tin metric tons	244,945	[9]3,873	2	261,631	[9]4,600	2
Zinc (primary and secondary) thousand metric tons	5,820	442	8	6,233	526	8
NONMETALS						
Asbestos do.	5,154	93	2	5,278	93	2
Barite	7,507	[10]2,112	28	7,635	[10]1,937	25
Bromine thousand pounds	683,613	446,500	65	763,600	[9]503,200	66
Cement	938,095	[11]85,480	9	957,791	[11]85,904	9
Clay, kaolin	21,271	[10]6,973	33	22,499	[10]7,761	34
Corundum	11	--	NA	11	--	--
Diamond thousand carats	38,953	--	NA	39,698	--	--
Diatomite	1,925	[10]651	34	1,954	[10]717	37
Feldspar	3,402	735	22	3,412	740	22
Fluorspar	5,282	129	2	5,360	109	2
Graphite	589	W	NA	577	W	NA
Gypsum	84,347	14,891	18	81,695	14,630	18
Iodine, crude thousand pounds	23,450	W	NA	24,620	W	NA
Lime (sold or used)	122,657	[10]20,484	17	124,613	[10]20,983	17
Magnesite	10,704	W	NA	11,086	W	NA
Mica (including scrap) thousand pounds	534,058	[12]278,000	52	527,773	[12]268,001	51
Nitrogen, N content of ammonia	72,835	14,232	20	77,188	14,932	19
Peat	224,256	822	(4)	223,813	825	(4)
Perlite	1,544	[10]641	42	1,571	[10]660	42

See footnotes at end of table.

Table 11.—Comparison of world and U.S. production of selected nonfuel mineral commodities —Continued

(Thousand short tons unless otherwise specified)

Mineral	1978			1979[p]		
	World production[1]	U.S. production	U.S. percent of world production	World production[1]	U.S. production	U.S. percent of world production
NONMETALS —Continued						
Phosphate rock ______ thousand metric tons__	145,163	50,037	35	127,190	51,611	41
Potash (K_20 equivalent) ____________do____	26,000	2,253	9	26,345	2,225	8
Pumice[3] ____________________________	19,600	4,761	24	19,484	4,416	23
Salt ________________________________	180,505	[11]42,896	24	184,958	[11]45,820	25
Strontium[3] _______________ metric tons__	85,608	--	NA	78,500	--	--
Sulfur, elemental _____ thousand metric tons__	53,399	11,175	21	54,834	12,101	22
Talc, pyrophyllite, soapstone _______________	6,475	[10]1,325	21	6,850	[10]1,453	21
Vermiculite[3] __________________________	616	[10]337	55	607	[10]346	57

[p] Preliminary. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1] For those commodities for which U.S. data is withheld to avoid disclosing company proprietary data, the world total excludes U.S. output and the U.S. percent of world production cannot be reported.

[2] U.S. figures represent dried bauxite equivalent of crude ore; to the extent possible, individual country figures which are included in the world total are also on the dried bauxite equivalent basis, but for some countries, available data is insufficient to permit this adjustment.

[3] World total does not include estimates for output in the U.S.S.R. or Mainland China.

[4] Less that 0.5 percent.

[5] Primary and secondary blister and anode copper, including electrowon refined copper which is not included as blister or anode.

[6] Includes bullion.

[7] Refined nickel plus nickel content of ferronickel.

[8] Data from American Iron and Steel Institute. Excludes production of castings by companies that do not report steel ingot.

[9] Includes tin content of alloys made directly from ore.

[10] Quantity sold or used by producers.

[11] Including Puerto Rico.

[12] Excludes sericite mica.

The Mineral Industry of Alabama

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey of Alabama for collecting information on all nonfuel minerals.

By James R. Boyle[1] and Thomas J. Joiner[2]

The value of Alabama's nonfuel mineral production in 1978 and 1979 was $331.2 million and $336.4 million, respectively. In 1978, nearly all commodities registered an increase in production and value; unit value increased for all commodities, with the exception of native asphalt and sand and gravel. Alabama led the Nation in the production of crushed marble and was second in bauxite, third in masonry cement, kaolin, native asphalt, and oyster shell, and fourth in bentonite, dimension marble, fire clay, and scrap mica.

Trends and Developments.—The Alabama State Docks at the Port of Mobile handled more than 10 million tons of bulk material in fiscal year 1978; volume dropped slightly to 9.8 million tons in fiscal 1979. Bulk materials comprise the major activity at the facility, with iron ore and bauxite being two of the major materials handled. The movement of these ores is vital to the operation of many heavy industries in the State.

Table 1.—Nonfuel mineral production in Alabama[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:						
Masonry -- thousand short tons --	345	$14,255	356	$17,293	303	$13,930
Portland ------------ do ----	2,351	79,302	2,837	108,972	2,578	103,187
Clays[2] ------------ do ----	2,677	21,984	2,782	24,885	2,571	33,824
Gem stones ------------------	--	--	NA	1	NA	2
Lime ------ thousand short tons --	1,149	39,213	1,264	49,021	1,273	54,182
Sand and gravel ---------- do ----	14,372	35,204	15,294	35,692	13,747	31,319
Stone:						
Crushed ------------ do ----	25,248	72,649	26,572	82,767	26,443	83,566
Dimension ------------ do ----	14	1,715	13	1,789	12	2,071
Combined value of asphalt (native), bauxite, clays (bentonite), mica (crude), phosphate rock (1978-79), and salt ------------------	XX	6,036	XX	10,871	XX	14,286
Total ------------------	XX	270,358	XX	331,241	XX	336,367

NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes bentonite; value included with "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Alabama, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Autauga	W	W	Sand and gravel.
Baldwin	W	W	Clays.
Barbour	W	W	Clays, bauxite, sand and gravel.
Bibb	W	W	Stone, clays.
Blount	W	W	Sand and gravel, cement, stone.
Calhoun	W	W	Stone, clays, sand and gravel.
Cherokee	$101	W	Sand and gravel.
Chilton	W	W	Sand and gravel, clays.
Clarke	W	W	Sand and gravel.
Clay	4	$4	Do.
Coffee	31	107	Do.
Colbert	W	W	Stone, native asphalt, sand and gravel.
Conecuh	W	W	Sand and gravel.
Covington	W	--	
Crenshaw	22	W	Sand and gravel.
Dale	215	W	Do.
Dallas	W	W	Sand and gravel, clays.
De Kalb	W	W	Stone.
Elmore	W	W	Sand and gravel, clays.
Escambia	W	857	Do.
Etowah	W	W	Stone, sand and gravel.
Fayette	184	184	Sand and gravel.
Franklin	W	W	Stone, sand and gravel.
Geneva	W	W	Sand and gravel.
Greene	--	W	Do.
Hale	270	233	Do.
Henry	W	W	Clays, bauxite, stone.
Houston	W	W	Sand and gravel.
Jackson	W	W	Stone.
Jefferson	W	W	Cement, stone, clays.
Lamar	W	W	Sand and gravel.
Lee	W	W	Stone.
Limestone	--	W	Phosphate rock.
Lowndes	W	W	Clays, sand and gravel.
Macon	2,207	3,682	Sand and gravel.
Madison	W	W	Stone, sand and gravel, clays.
Marengo	W	W	Cement, stone.
Marion	320	275	Sand and gravel, clays.
Marshall	W	W	Stone, sand and gravel, clays.
Mobile	22,882	W	Cement, sand and gravel, stone, clays.
Monroe	38	323	Sand and gravel.
Montgomery	W	W	Sand and gravel, clays.
Morgan	W	W	Stone.
Randolph	W	W	Stone, mica.
Russell	817	W	Sand and gravel, clays.
St. Clair	W	W	Cement, clays, stone, sand and gravel.
Shelby	W	W	Lime, cement, stone, clays.
Sumter	W	2,122	Clays, sand and gravel.
Talladega	W	W	Stone.
Tuscaloosa	989	913	Sand and gravel.
Walker	199	878	Clays.
Washington	W	W	Salt, stone, sand and gravel.
Undistributed[2]	242,029	321,663	
Total	270,358	331,241	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] The following counties are not listed because no nonfuel mineral production was reported: Bullock, Butler, Chambers, Choctaw, Cleburne, Coosa, Cullman, Lauderdale, Lawrence, Perry, Pickens, Pike, Tallapoosa, Wilcox, and Winston.

[2] Includes gem stones which cannot be assigned to specific counties and values indicated by symbol W.

Major imports through the State Docks facilities included bauxite (877,000 tons), iron ore (1.4 million tons), manganese (58,000 tons), ilmenite (21,000 tons), and rutile (9,000 tons). In addition to direct handling of raw materials, the general port tonnage through private facilities included 2.6 million tons, mostly iron ore.

A major phase of the modernization program at the State Docks was completed when a new 1,500-ton-per-hour unloader was put into service in 1979. This ship unloader will be used to more efficiently transfer ores from ships to the recently renovated conveyor system to storage.

Recent foreign acquisitions in the minerals industry in Alabama include Citadel Cement's operations at Demopolis and Birmingham, now owned by Lafarge Ltd. (Canada), and National Cement Co., Inc.'s Ragland plant, now owned by Société des Ciments Vicat (France). In 1978, National

Cement Co., Inc.'s Ragland plant completed an expansion program which increased capacity from 360,000 tons to 1 million tons per year.

In 1979, Autlan Manganese Corp., subsidiary of Compania Autlan, S.A., of Mexico City, acquired the Airco Alloys plant in Mobile. The plant will continue to produce ferroalloys for U.S. foundries and steelmaking firms. Manganese nodules, mined and refined in Mexico, are being shipped to Mobile. The first shipment of ore was received in 1979.

Republic Steel Corp. continued its 2-year, $50 million expansion and upgrading project at its Gadsen plant. Some $16 million in improvements to the firm's steel producing facility were completed in 1979. A sixth roll was added to the plant's finishing mill, and a massive maintenance job on one of the blast furnaces and upgrading of the slab reheating furnace were scheduled for completion. In 1978, raw steel production topped 1.3 million tons, up from 1.2 million tons in 1977.

U.S. Pipe & Foundry Co. completed a $5 million expansion of its Bessemer pipe plant, which now is capable of production of pipe up to 54 inches in diameter. The company also installed a $600,000 electric holding furnace at its Anniston facility. The new furnace will allow production of general castings in addition to its production of soil pipe, pressure fittings, and valve and hydrant parts.

The United States Steel Corp. received permission from the Alabama Air Pollution Control Commission to put its third bottom-blown oxygen (Q-BOP) steelmaking furnace into production. Installation of the final Q-BOP furnace, a new 5,000-ton-per-day blast furnace, and a 900,000-ton-per-year coke battery will complete the current renovation at the Fairfield works. The computer-controlled blast furnace will consume 8,000 tons of iron ore, 3,000 tons of coke, and 500 tons of limestone per day. During 1979, the company shut down its 140-inch plate mill at Fairfield for an indefinite period because of sagging demand and high operating costs.

Table 3.—Indicators of Alabama business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	1,533.0	1,587.0	1,624.0	+2.3
Unemployment do	114.0	101.0	116.0	+14.9
Employment (nonagricultural):				
Mining[1] do	13.9	14.1	16.7	+18.4
Manufacturing do	354.3	368.9	374.6	+1.5
Contract construction do	75.9	78.8	75.4	-4.3
Transportation and public utilities do	65.0	69.8	71.9	+3.0
Wholesale and retail trade do	259.1	269.7	275.8	+2.3
Finance, insurance, real estate do	55.4	57.5	58.2	+1.2
Services do	179.3	191.8	198.2	+3.3
Government do	266.3	285.9	292.0	+2.1
Total nonagricultural employment[1] do	1,269.2	1,336.5	1,362.8	+2.0
Personal income:				
Total millions	$20,867	$23,668	$26,294	+11.1
Per capita	$5,654	$6,325	$6,976	+10.3
Construction activity:				
Number of private and public residential units authorized	23,562	[2]20,953	17,498	-16.5
Value of nonresidential construction millions	$325.6	$379.3	$454.0	+19.7
Value of State road contract awards do	$192.0	NA	$311.1	--
Shipments of portland and masonry cement to and within the State thousand short tons	1,537	1,639	1,386	-15.4
Nonfuel mineral production value:				
Total crude mineral value millions	$270.4	$331.2	$336.4	+1.6
Value per capita, resident population	$73	$89	$89	--
Value per square mile	$5,239	$6,418	$6,518	+1.6

[p] Preliminary. NA Not available.

[1] Includes bituminous coal and oil and gas extraction.

[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

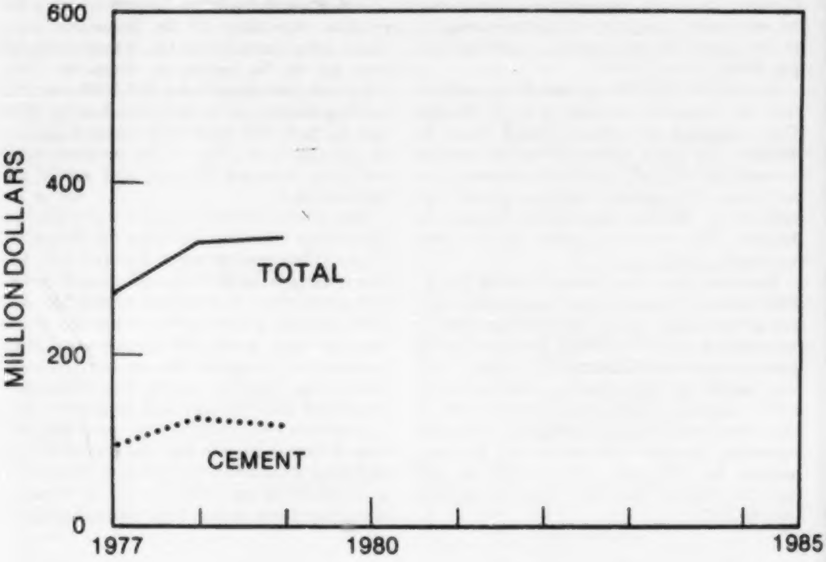

Figure 1.—Value of cement and total value of nonfuel mineral production in Alabama.

Legislation and Government Programs.—The Corps of Engineers issued a permit to the Aluminum Company of America (Alcoa) for expansion of a waste disposal area on Blakeley Island. The wastes are from Alcoa's alumina plant in Mobile, where alumina is produced from imported bauxite. The company will accept 10 million cubic yards of dredged material from Mobile Bay for top dressing on the disposal areas to convert them to wildlife management areas. Upon completion, these wildlife areas will be managed jointly by the State, the Mobile County Wildlife Federation, and the Mobile Bay Audubon Society.

The Federal Bureau of Mines contracted with Jim Walter Resources, Inc., Tuscaloosa County, in 1979 to conduct a methane control demonstration project. The objective of the project is to drain methane gas from a part of the Mary Lee coal seam by drilling long horizontal holes in advance of mining. This activity is part of the Bureau's continuing research work in the health and safety area.

Due to increased enrollment, a separate Department of Mineral Engineering has been established in the College of Engineering at the University of Alabama. Under this reorganization, the former Department of Civil and Mineral Engineering has been separated into two units.

In 1978, the University of Alabama was designated by the Secretary of the Interior as a State Mining and Mineral Resources and Research Institute pursuant to Title III of Public Law 95-87. The institute established training programs and provided scholarships and fellowships in mining and minerals extraction.

The Mineral Resources Institute of the University of Alabama conducted research for industry and various governmental units on upgrading clays, iron ore availability, and solid waste utilization.

The Alabama Development Office (ADO), through its State Planning Division, was active in several areas related to the minerals industry. ADO administered geologic and minerals investigations conducted by the Geological Survey of Alabama to assist potential industrial developers.

The Geological Survey of Alabama conducted investigations and published various reports in cooperation with local, State, and Federal agencies. Mineral studies included an evaluation of mineral resources in Lamar, Pickens, Fayette, Tuscaloosa, and Bibb Counties for the Appalachian Regional Commission. The third-year effort of a 5-year cooperative program (related in part to mineral resources) with county and city governments in Jefferson County was also completed. In addition, the Survey provided assistance to the U.S. Soil Conservation Service concerning mineral resources development in the Black Warrior River Basin and to the Alabama Surface Mining Reclamation Commission regarding proposed Federal strip mining regulations. The Survey investigated the geothermal-geopressure potential of the Gulf Coastal Plain with the University of Alabama, and assisted Auburn University in preparation of a report identifying the minerals of Alabama.

Project work started in the latter part of 1978 by the Survey included a review of geologic and hydrologic studies required by Federal and State strip mining regulations. In addition to numerous open file reports, 28 formal publications were issued.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Nonmetals accounted for the bulk of the value of Alabama's total nonfuel mineral production.

Asphalt (Native).—Alabama ranked third in the Nation in production of native asphalt. Southern Stone Co. produced native asphalt at the Margerum quarry in Colbert County. Annual output declined 19% in 1978, but returned to the previous level in 1979.

Cement.—Cement accounted for more than one-third of the value of nonmetallic mineral production. Nationally, Alabama ranked third in the production of masonry cement and seventh in portland cement.

Portland cement was produced at seven plants in the State; three were located in Jefferson County, and one each in Marengo, Mobile, St. Clair, and Shelby Counties. Major end uses for portland cement were as follows: Ready-mix concrete, concrete products, building materials, and highway construction.

In 1978 and 1979, raw materials used in making cement totaled over 7 million tons of cement rock, limestone, clay, sand, shale, iron ore, oyster shell, and other materials.

Table 4.—Alabama: Portland cement salient statistics

(Short tons)

	1978	1979
Number of active plants	7	7
Production	2,954,787	2,681,824
Shipments from mills:		
Quantity	2,837,074	2,577,793
Value	$108,972,171	$103,186,956
Stocks at mills, Dec. 31	161,897	273,053

Table 5.—Alabama: Masonry cement salient statistics

(Short tons)

	1978	1979
Number of active plants	6	6
Production	354,772	307,802
Shipments from mills:		
Quantity	356,491	302,624
Value	$17,293,261	$13,929,963
Stocks at mills, Dec. 31	22,648	29,100

Ideal Basic Industries, Inc.'s new 1.5-million-ton-per-year dry process plant at Theodore is scheduled to be onstream in 1981. This plant, estimated to cost $17.5 million in 1977 dollars, will eventually replace the present Mobile plant. Southern Industries Corp. will transport by barge approximately 3 million tons per year of limestone, sand, and clay from Ideal's new quarry in Monroe County to the new plant.

Clays.—In 1978 and 1979, Alabama's clay industry produced common clay, fire clay, kaolin, and bentonite. The State ranked third nationally in the production of kaolin and fourth in bentonite and fire clay. During 1978, 30 companies mined clay at 53 pits in 21 counties; 19 companies mined common clay at 28 pits; 5 companies mined fire clay at 6 pits; 5 companies mined kaolin in 17 pits; and 1 company mined bentonite at 2 pits. Of the 53 pits, 90% of the total production of clays came from 33 pits. In 1979, industry production and structure were comparable to those of the previous year.

National Gypsum Company plans an expansion of its American Olean Tile Company subsidiary with the construction of a new quarry tile plant in Fayette. The plant, expected to be in operation in 1980, will increase American Olean's quarry tile production capacity about 45%. Original testing of the raw materials was done at the Federal Bureau of Mines' Tuscaloosa Research Center.

Lime.—Alabama ranked sixth nationally in the production of lime. Production came from four plants in Shelby County. Major uses are in basic oxygen steelmaking, paper manufacture, and water purification.

Table 6.—Alabama: Lime sold or used by producers, by use

Use	1977		1978		1979	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Paper and pulp	431,200	$14,691	329,224	$12,843	351,042	$14,946
Water purification	128,600	4,383	140,295	5,473	154,322	6,571
Mason's lime	W	W	26,093	1,018	19,506	788
Soil stabilization	W	W	37,536	1,357	14,836	632
Aluminum and bauxite	W	W	31,833	1,242	2	2
Sugar refining	7,275	248	6,158	240	4,401	187
Other uses[1]	582,400	19,891	693,100	26,848	728,443	31,058
Total[2]	1,149,470	39,213	1,264,240	49,021	1,272,550	54,182

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes acid mine water; agriculture (1978-79); alkalies; calcium carbide; fertilizer (1978-79); food and food byproducts; insecticides (1978); metallurgy (1979); oil well drilling; ore concentration; other chemical uses; other construction lime; sewage treatment; steel, BOF; steel, electric; steel, open-hearth; tanning; wire drawing (1978); and uses indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Mica.—Alabama ranked fourth in the Nation in the production of scrap mica. Western Mica Co. produced scrap mica at its Heflin operation from material mined in Randolph County. The fine-ground mica is used as an additive in paints.

Phosphate Rock.—Monsanto Co. produced phosphate rock from the Gilbert pit in Limestone County. This is the first recorded production in Alabama since 1970. The phosphate rock was shipped to Tennessee for further processing.

Salt.—Alabama ranked ninth nationally in the production of salt. The Olin Corp. produced salt from well brines from a near-surface salt dome in Washington County for use in chemical manufacture. Both production and value increased significantly in 1978.

Sand and Gravel.—In 1978 and 1979, sand and gravel was produced at over 100 operations in slightly more than half of the counties in the State. Of the sand and gravel produced, the majority was used for construction purposes, with minor amounts for industrial uses. The price of construction sand and gravel averaged less than half that of industrial sand and gravel. The major portion of sand and gravel was shipped by truck with lesser amounts transported by railroad and waterway. Leading counties were Montgomery, Mobile, Elmore, and Macon.

Table 7.—Alabama: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	7,045	$16,941	$2.40	7,889	$18,450	$2.34	7,281	$18,234	$2.50
Plaster and gunite sands	NA	NA	NA	--	--	--	W	W	W
Concrete products	1,307	3,338	2.55	654	1,966	3.01	398	1,155	2.91
Asphaltic concrete	1,758	4,016	2.28	2,475	5,912	2.39	1,949	4,906	2.52
Roadbase and coverings	1,657	2,568	1.55	2,463	4,165	1.69	2,304	3,742	1.62
Fill	1,013	1,090	1.08	1,017	1,144	1.12	1,387	1,614	1.16
Snow and ice control	NA	NA	NA	--	--	--	W	W	W
Other uses	89	248	2.79	32	79	2.44	62	194	3.12
Total[1] or average	12,869	28,201	2.19	14,531	31,716	2.18	13,451	29,944	2.23

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Table 8.—Alabama: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	6,584	$12,781	$1.94	8,625	$17,184	$1.99	7,419	$13,115	$1.77
Gravel	6,286	15,420	2.45	5,906	14,532	2.46	6,031	16,828	2.79
Total[1] or average	12,869	28,201	2.19	14,531	31,716	2.18	13,451	29,944	2.23
Industrial:									
Sand	W	W	W	293	1,411	4.82	W	W	W
Gravel	W	W	W	470	2,585	5.46	W	W	W
Total or average	1,503	7,003	4.66	763	3,976	5.21	297	1,375	4.63
Grand total[1] or average	14,372	35,204	2.45	15,294	35,692	2.33	13,747	31,319	2.28

W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Stone.—Stone ranked second in terms of mineral value in Alabama in both 1978 and 1979. Crushed stone in 1978 was produced at 47 operations in 20 counties. It was used in cement manufacture, in concrete, and as roadbase. Shelby and Jefferson Counties were the leading producing counties. Ten quarries each produced in excess of 900,000 tons per year and accounted for nearly 44% of all crushed stone. Four companies produced dimension stone for cut stone, rough blocks, sawed stone, and other uses. Shipments were mainly by truck, with a minor portion of total shipments by rail or waterway.

Nationally, Alabama led in output of crushed marble, ranked third in production of oyster shell, and was fourth in dimension marble.

Table 9.—Alabama: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	1,595	4,818	1,411	5,330	1,873	5,942
Concrete aggregate	[2]2,704	[2]6,336	2,784	7,447	3,646	9,247
Bituminous aggregate	2,603	6,379	2,851	7,166	2,618	7,855
Dense-graded roadbase stone	3,319	7,781	2,340	5,968	1,934	4,432
Surface treatment aggregate	274	520	377	922	181	273
Other construction aggregate and roadstone	5,065	9,531	4,907	11,131	3,495	9,938
Riprap and jetty stone	402	1,036	644	1,927	924	2,855
Railroad ballast	108	232	W	W	189	517
Manufactured fine aggregate (stone sand)	W	W	463	1,166	243	706
Cement	4,475	9,564	5,347	10,854	5,140	11,502
Lime	1,813	8,314	1,931	9,366	2,848	10,415
Dead-burned dolomite	--	--	W	W	193	W
Flux stone	1,577	3,809	1,677	4,014	1,943	5,462
Whiting or whiting substitute	W	W	W	W	276	2,567
Other fillers or extenders	545	7,971	481	7,905	W	W
Other uses[3]	767	6,356	1,360	9,571	987	11,855
Total[4]	25,248	72,649	26,572	82,767	26,443	83,566

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, marble, sandstone (1979), and shell.

[2] Includes manufactured fine aggregate (stone sand).

[3] Includes stone used for agricultural marl and other soil conditioners (1978-79), poultry grit and mineral food, macadam aggregate, filter stone, terrazzo and exposed aggregate, abrasives (1979), mine dusting, asphalt filler (1977-78), refractory stone (1977), porcelain (1978-79), roofing granules (1978-79), sulfur removal from stack gases (1979), unspecified uses, and uses indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

Sulfur.—Alabama ranked fourth nationally in output of recovered sulfur. Four companies recovered sulfur from five sour-crude-oil processing plants in Escambia, Tuscaloosa, and Washington Counties. Exxon Co., Hunt Oil Co., Mallard Exploration, Inc., and Phillips Petroleum sold 404,281 metric tons in 1978, valued at $18.4 million. In 1979, sales dropped to 374,526 metric tons, but value increased to $20.3 million.

METALS

Primary metal production was among the most important industries in the State. According to a Bureau of the Census survey issued in 1979, metal production accounted for 41,800 jobs and contributed $688 million to the State's economy. The four most important counties were Jefferson, Mobile, Madison, and Etowah.

Aluminum.—Alabama ranked fifth nationally in the production of primary aluminum. Primary aluminum was produced by Revere Copper and Brass, Inc., and Reynolds Metals Co., from alumina shipped in from Texas and Arkansas.

Revere Copper and Brass, Inc., Scottsboro, increased its aluminum potline capacity in 1978 from 109,000 to 117,000 short tons, with further increases anticipated. The company rebuilt and enlarged the capacities of four ingot heating furnaces for processing rolling ingot and installed a new pusher furnace.

Reynolds Metals Co. was constructing a $5 million plant in Sheffield to process automobile shredder residues. Reynolds expects to recover 5,000 tons of aluminum the first year. Expected completion date of the plant is June 1980.

Aluminum Company of America, Mobile, which produces alumina from imported bauxite, will spend $60 million to modernize its alumina plant. The plant's capacity will be expanded by 70,000 tons per year above the present 900,000-ton-per-year capability. Major expansion will be in the chemical products section. Three of the four existing digester units will be replaced and a new drying system constructed. The chemical plant produces alumina trihydrate, which is used in the manufacture of water treatment chemicals and as a flame retardant.

Bauxite.—Alabama ranked second in the Nation in bauxite production. Six companies mined bauxite in Barbour and Henry Counties for use in refractories and chemical manufacture.

Iron and Steel.—Alabama ranked seventh in the Nation in the production of pig iron. In 1978, production increased 8.0% over that of the previous year to nearly 3.5 million short tons and was valued at $679.5 million; 1979 production was 3.7 million short tons, valued at $738.4 million. U.S. Steel Corp., Fairfield, and Republic Steel Corp., Gadsen, were the major producers.

Rutile (Synthetic).—Kerr-McGee Corp. will reopen its 100,000-ton-per-year synthetic rutile plant in Mobile in early 1980, after a 2-year shutdown. The facility opened in mid-1977 and closed in March 1978 because of poor market conditions and the need for better product and environmental control. Ilmenite imported from Australia is processed into synthetic rutile, which is used as a pigment in paint.

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[1] State mineral specialist, Bureau of Mines, Tuscaloosa, Ala.

[2] State geologist, Geological Survey of Alabama, Tuscaloosa, Ala.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Alumina:			
Aluminum Company of America	1501 Alcoa Bldg. Pittsburgh, PA 15219	Plant	Mobile.
Aluminum smelters:			
Revere Copper & Brass Inc	Box 191 Rome, NY 13440	do	Jackson.
Reynolds Metals Co	Reynolds Metals Bldg. Richmond, VA 23218	do	Colbert.
Bauxite:			
Eufaula Minerals Co	Box 556 Eufaula, AL 36027	Mine and plant	Barbour.
Harbison-Walker Refractories Co., Inc., a division of Dresser Industries, Inc.	Dale Rd. Route 1, Box 58 Eufaula, AL 36027	do	Do.
United States Gypsum Co.[1]	Mexico, MO 65265	do	Do.
Wilson-Snead Mining Co	Box 568 Eufaula, AL 36027	do	Barbour and Henry.
Cement:			
Alpha Portland Industries, Inc	15 South 3d St. Easton, PA 18042	Plant	Jefferson.
Citadel Cement Corp	2625 Cumberland Pkwy., NW. Atlanta, GA 30339	do	Jefferson and Marengo.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Cement —Continued			
Ideal Basic Industries, Inc.[2]	821 17th St. Denver, CO 80202	Plant	Mobile.
Martin Marietta Corp.[3]	6901 Rockledge Dr. Bethesda, MD 20034	do	Shelby.
National Cement Co. Inc	Drawer A Ragland, AL 35131	do	St. Clair.
U.S. Steel Corp	Box 509 Fairfield, AL 35064	do	Jefferson.
Clays:			
American Colloid Co	5100 Suffield Court Skokie, IL 60076	Mine	Loundes.
Bickerstaff Clay Products Co., Inc	Box 517 Bessemer, AL 35020	do	Jefferson and Russell.
Drummond Coal Co	Route 1, Box 207 Cordova, AL 35550	do	Walker.
Tombigbee Lightweight Aggregate Corp., a division of Breeko Industries, Inc.	Box V Livingston, AL 35470	do	Sumter.
Ferroalloys:			
Airco Alloys and Carbide	Box 2703 Mobile, AL 36601	Plant	Mobile.
Alabama Metallurgical Corp	Box 348 Selma, AL 36701	do	Dallas.
Tennessee Alloys Corp	818 National Bank Bldg. Chattanooga, TN 37402	do	Jackson.
Tennessee Valley Authority	Muscle Shoals, AL 35660	do	Colbert.
Union Carbide Corp	Box 176 Marietta, OH 45750	Plants	Colbert and Jefferson.
Woodward Co	Woodward, AL 35189	Plant	Jefferson.
Lime:			
Allied Products Co	Drawer 1 Montevallo, AL 35115	do	Shelby.
Cheney Lime & Cement Co.[4]	Allgood, AL 35013	do	Do.
Martin Marietta Corp.[5]	Box 182 Calera, AL 35040	do	Do.
S. I. Lime Co	500 Southland Dr. Birmingham, AL 35226	do	Do.
Pig iron:			
Republic Steel Corp	1629 Republic Bldg. Cleveland, OH 44115	Furnaces and mills.	Etowah and Jefferson.
U.S. Pipe and Foundry Co	3300 1st Ave., North Birmingham, AL 35202	Furnaces	Jefferson.
United States Steel Corp.[5]	Box 599 Fairfield, AL 35064	Furnaces and mills.	Do.
Salt:			
Olin Corp	120 Long Ridge Rd. Stanford, CT 06904	Brine wells	Washington.
Sand and gravel:			
Dallas Sand & Gravel Co	Box 892 Selma, AL 36701	Surface mine and plant.	Autauga.
Dixie Sand & Gravel	Box 1128 Montgomery, AL 36102	Dredge and plant	Montgomery.
Holland and Woodward Co., Inc	Box 1947 Decatur, AL 35601	Surface mine and plant.	Franklin.
Waugh Sand & Gravel, Inc	Box 3547 Montgomery, AL 36109	do	Elmore, Macon, Montgomery.
Stone:			
Southern Stone Co., Inc.[6]	2111 8th Ave., South Birmingham, AL 35233	Quarries	Bibb, Colbert, Lee, Shelby.
Trinity Stone Co., Inc	Drawer E Decatur, AL 35601	Quarry	Morgan.
Vulcan Materials Co.[7]	Box 7324-A Birmingham, AL 35223	Quarries	Calhoun, Colbert, Etowah, Franklin, Jackson, Madison, Shelby.
Wade Sand and Gravel Co., Inc	Box 39048 Birmingham, AL 35208	Quarry	Jefferson.
Talc:			
American Talc Co., Inc	Alpine, AL 35014	Plant	Talladega.

[1] Also clays and scrap mica.
[2] Also clays.
[3] Also lime, stone, clays.
[4] Also cement.
[5] Also cement, coal, coke, stone.
[6] Also sand and gravel.
[7] Also clays and sand and gravel.

[illegible]

The Mineral Industry of Alaska

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Alaska Department of Natural Resources for collecting information on all nonfuel minerals.

By Tom L. Pittman[1]

The reported value of nonfuel mineral production in Alaska in 1978 and 1979 was $163.7 million and $123.4 million, respectively. This change is mostly due to the changes in the reported values for sand and gravel and gold. The quantities of tungsten concentrates and antimonial ores and concentrates were about the same in 1978 and 1979. Barite production was resumed in 1979 and crude ore was shipped.

Exploration expenditures reached an apparent maximum in 1978, estimated at between $60 and $75 million. Expenditures in 1979 are estimated to be 65 to 80% of the amount expended in 1978. Interest remained high in exploration for gold and silver, molybdenum, tin, copper, lead, and zinc. Tungsten, nickel, and cobalt were given special attention in some areas. New claim location recordings in 1979 were about half of the recordings in 1978. A large proportion of claims made in earlier years were maintained in good standing. A large proportion of expenditures in 1979 were for drilling, geologic and other exploratory work on major prospects, and on smaller prospects showing promise of relatively high-grade ores. In 1978, 21,154 new mining claims

Table 1.—Nonfuel mineral production in Alaska[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Gem stones	NA	$60	NA	$60	NA	$60
Gold (recoverable content of ores, etc.) troy ounces	18,962	2,812	18,652	3,610	6,675	2,053
Sand and gravel thousand short tons	66,426	134,251	69,300	145,300	50,900	104,905
Silver (recoverable content of ores, etc.) troy ounces	2,000	8	2,000	11	(²)	5
Stone:						
Crushed thousand short tons	4,008	17,493	3,437	14,649	3,656	15,458
Dimension do	(²)	1	--	--	--	--
Combined value of copper (1977-78), tin (1978-79), and tungsten	XX	10	XX	31	XX	938
Total	XX	154,635	XX	163,661	XX	123,419

NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Less than 1/2 unit.

Table 2.—Value of nonfuel mineral production in Alaska, by region[1]

(Thousands)

Region	1977	1978	Minerals produced in 1978 in order of value
Bristol Bay	$8	--	
Cook Inlet-Susitna	4,011	$10,486	Sand and gravel, gold, stone, silver.
Copper River	W	287	Stone, sand and gravel.
Kenai Peninsula	454	323	Sand and gravel, gold, silver, lead.
Kodiak	W	W	Sand and gravel, stone.
Kuskokwim	W	W	Tungsten.
Northern Alaska	W	13	Sand and gravel.
Seward Peninsula	W	W	Sand and gravel, stone, gold, tin.
Southeastern Alaska	W	W	Stone, sand and gravel.
Yukon River	1,187	1,392	Sand and gravel, copper, silver.
Undistributed[2]	148,976	151,204	
Total[3]	154,635	163,661	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] No production was reported in Alaska Peninsula, Aleutian Islands, Bering Sea, and Northwestern Alaska Regions.

[2] Includes gem stones, some sand and gravel, gold, and silver that cannot be assigned to specific regions.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Alaska business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	175.0	181.0	180.0	-.6
Unemployment	do	16.0	20.0	16.0	-20.0
Employment (nonagricultural):					
Mining[1]	do	5.0	5.6	5.7	+1.8
Manufacturing	do	10.9	11.7	12.6	+7.7
Contract construction	do	19.6	12.1	10.1	-16.5
Transportation and public utilities	do	16.2	16.4	16.8	+2.4
Wholesale and retail trade	do	28.3	28.9	29.7	+2.8
Finance, insurance, real estate	do	6.2	8.1	8.6	+6.2
Services	do	27.0	27.9	30.0	+7.5
Government	do	50.1	53.6	54.8	+2.2
Total nonagricultural employment[1]	do	163.3	164.3	168.3	+2.4
Personal income:					
Total	millions	$4,313	$4,369	$4,568	+4.6
Per capita		$10,455	$10,849	$11,252	+3.7
Construction activity:					
Number of private and public residential units authorized		6,912	[2]4,651	2,693	-42.1
Value of nonresidential construction	millions	$157.3	$85.5	$78.3	-8.4
Value of State road contract awards	do	$111.8	$46.0	$90.0	+95.7
Shipments of portland cement to and within the State	thousand short tons	120	116	90	-22.4
Nonfuel mineral production value:					
Total crude mineral value	millions	$154.6	$163.7	$123.4	-24.6
Value per capita, resident population		$374	$406	$304	-25.1
Value per square mile		$264	$279	$210	-24.7

[p] Preliminary.

[1] Includes bituminous coal and oil and gas extraction.

[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

were recorded on Federal and State lands. Annual assessment work was recorded on 50,942 claims, giving a total of 72,096 Federal and State claims. Through October 22, 1979, the Bureau of Land Management reported 59,296 mining claims on federal land had been recorded as required by provisions in the Federal Land Management and Policy Act.

Increases in exploration effort and the

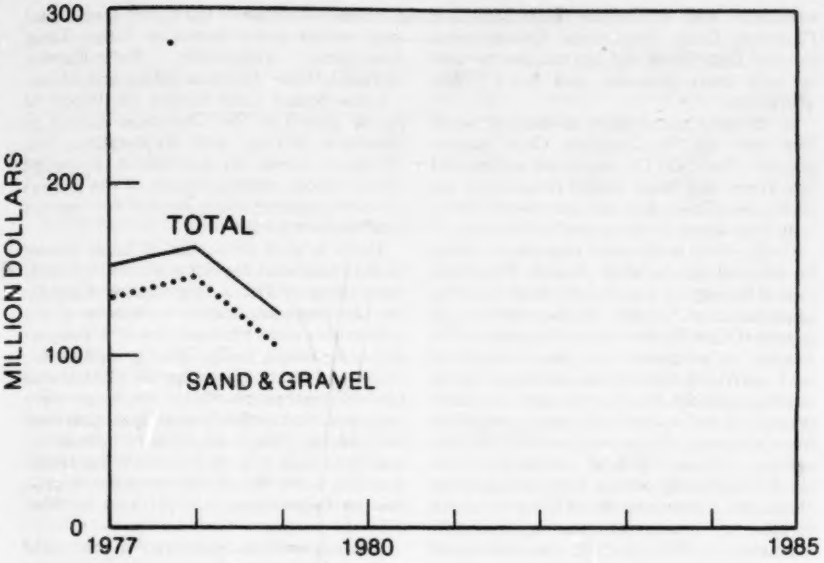

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Alaska.

normal progression of otherwise viable prospects to producing mines will be slow until many of the problems facing the private mineral sector are resolved. Most of the problems are due to uncertainties in land tenure, access, and the economic implications of regulations and the permitting requirements of land and resource managing agencies. Some provisions in current and proposed water-rights and in-streamflow legislation are of vital interest. Certain aspects of the developing district coastal zone management programs may become decisive elements in planning some mining, milling, and related transportation projects.

Legislation and Government Programs.—In November 1978, Secretary of the Interior Andrus, using authority contained in Section 204 (E) of the Federal Land Policy and Management Act (PL94-579), withdrew from development 110 million acres of Federal lands.

In December, President Carter created 17 new national monuments under authority of the Antiquities Act of 1906 covering 56 million acres of the land withdrawn by the Secretary of the Interior.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Copper.—Exploration of a series of copper, zinc, lead, and silver deposits continued along the so-called schist belt in the central Brooks Range. Bear Creek Mining Co. continued work on its very large Arctic Camp deposit and performed necessary work at Bornite. Ambler Mining Co. was formed by the Anaconda Co. and Sunshine Mining Co. to operate certain of their deposits. This company continued a vigorous exploration program. Other companies active in the Ambler district were Union Carbide Corp., Houston Oil and Minerals Corp., General Crude Oil Co., Noranda Exploration, Inc., and Falconbridge Nickel Mines, Ltd.

The Orange Hill copper-molybdenum deposit north of the Wrangell Mountains and east of the terminus of Nabesna Glacier was examined and drilled by U.S. Borax & Chemical Corp. Inspiration Development Co. and Bear Creek did the necessary work to hold their Nabesna and Bond Creek properties.

In southeastern Alaska, assessment work was done on the Sumdum Chief copper deposit. Placid Oil Co. examined and drilled the Tracy and Magi Group copper-zinc deposit area. These deposits are east of Holkham Bay, about 45 miles south of Juneau.

Gold.—Gold is the most important metallic mineral produced in Alaska. The Division of Geological and Geophysical Surveys, Department of Natural Resources, State of Alaska (DG&GS), develops estimates for the number of producers and the quantity of gold recovered through observations by its mining geologist, mining engineer, and field personnel. It also uses information acquired from industry, private entities, and outside-agency sources. DG&GS estimates show about 60,000 troy ounces was recovered by about 200 operators in 1978, and about 65,000 troy ounces recovered by over 200 operators in 1979. In 1979, the number of respondents to the Bureau of Mines annual commodity canvass dropped to between 5% and 15% of the estimated number of placer gold producers. The quantity of gold produced by the respondents fell within about the same proportion of the estimated quantity of gold produced in Alaska.

Individual placer operators have reported recovering amounts of gold ranging from 1 troy ounce to several thousand troy ounces during the 1979 mining season. Gold was recovered chiefly from stream gravel and bench gravel deposits. Methods of recovery reported and observed were by bucket-line dredges, nonfloat washing plants, hydraulicking, dragline dredging, suction dredging, small-scale mechanical methods, and hand methods.

Alaska Gold Co. operated its Dredge No. 5 on Dry Creek and Dredge No. 6 on the Submarine Beach, near the Nome Airport, during the 1978 mining season. Dredge No. 5 was not operated in 1979. Extensive drilling and preparatory work was accomplished to increase the rate of cold-water thawing ahead of the dredges. Two small dredges operated as family enterprises and several other placer operations were active on the Seward Peninsula. The Livengood area, about 60 miles north of Fairbanks, was very productive, and many other placers operated in the Fairbanks district. About 25 mines operated in the Fortymile area and 15 mines in the Circle area. Other very active areas included Ruby, Long, Kantishna, Petersville, Tofty-Eureka, McGrath-Ophir, Iditarod, Inoko, and Aniak.

Little Squaw Gold Mining Co. leased its placer claims in the Chandalar district to Whelan's Mining and Exploration, Inc. Whelan's moved in equipment, upgraded access routes, explored parts of the property, and prepared some ground for current and future mining.

The lode gold properties of Little Squaw in the Chandalar district were active during the 1978 and 1979 mining seasons. Chandalar Development Associates, lessees of the lode claims, rehabilitated the 100 ton-per-day mill, shops, camp, mining equipment, roads, and airstrips serving the Mikado and Little Squaw mines. Mine workings were reopened, and several stopes were prepared for mining. Test runs were completed on ores from each mine before work was terminated in early September by snow storms. Resumed operations are planned for May 1980.

Industry sources report a small amount of gold production from lode mines near Fairbanks and in the Willow Creek district, west of Palmer. A cleanup operation at the old Alaska Juneau mill has produced "lode" gold during 1978 and 1979.

Exploration interest in lode gold prospects continued to increase. The Big Hurrah mine and several other prospects were being investigated on the Seward Peninsula. In the Fairbanks area, Placid Oil Co. examined the Vetter gold-antimony property near Cleary Hill. St. Joe American Corp. did evaluation work at the Ryan Lode (Bartholomae) mine west of Fairbanks. The Independence mine, in the Willow Creek district was acquired by Starkey A. Wilson, who was having the underground workings reopened, mapped, and sampled.

Occidental Minerals Corp. was doing geological and geochemical work at the old Treadwell-group mines in preparation for planned diamond drilling in 1980. This property is just south of Douglas, on Douglas Island, and about 3 miles south of Juneau. Mapco, Inc., drilled and explored the Sweetheart Ridge gold-copper-zinc-lead prospect and nearby claims about 30 miles southeast of Juneau. Mapco also investigated gold prospects on Prince of Wales Island.

Lead and Zinc.—A relatively new deposit area about 20 miles southwest of Tok is attracting exploration projects. This area is

Table 4.—Alaska: Placer production of gold

Year	Mines producing	Material[1] treated (thousand cubic yards)	Gold recovered		
			Troy ounces	Value (thousands)	Average value per cubic yard
1975	23	1,751	14,980	$2,419	$1.382
1976	26	1,699	22,605	2,833	1.667
1977	22	1,800	18,924	2,807	1.559
1978	21	1,455	18,599	3,600	2.474
1979	14	778	6,675	2,053	2.639

[1] Excludes material treated primarily for the recovery of platinum.

often referred to as the Delta mineral belt. Major values are in zinc and lead, with minor amounts of copper and silver. Thirty-seven deposits have been reported in the district through 1979. They are described as stratiform sulfide deposits.

There were extensive exploration and drilling programs in the Delong Mountains, a western part of the Brooks Range about 80 miles northwest of Kotzebue. A group composed of General Crude, Houston Oil and Minerals, and WGM Inc., operated two exploration camps on their properties in 1979. After the 1978 season, they announced having 19 million tons of evaluated reserves averaging 3.35% lead, 9.3% zinc, and 1.4 troy ounces of silver per ton in the Wulik River area. Cominco American, Inc., continued drilling its Lik and Su properties.

Geologists of the Bureau of Mines discovered several mineral occurrences along the southern part of the National Petroleum Reserve of Alaska. They were engaged in mineral resource work on Reserve lands that are withdrawn from mineral entry. These occurrences are similar in mineralogy and character to the Red Dog - Wulik River deposits. Work by the Geological Survey suggests similarities in the respective host rocks. These discoveries may indicate a possible major mineral belt extending at least 120 miles easterly along the north side of the Brooks Range. This area is in the Misheguk Mountain and the Howard Pass Quadrangles, about 200 miles northeast of Kotzebue.

Anaconda has located prospects near Mount Schwatka, northeast of Fairbanks. The deposit area was subsequently included in the Yukon Flats National Monument.

Geologic trends favorable for zinc-lead-copper-silver deposits have been identified in southeast Alaska. One such trend on Admiralty Island, extends from north of Greens Creek southerly past Gambier and Pybus Bays. Pan Sound Joint Venture (Noranda) has identified several prospects north of Greens Creek, and the "Greens Creek" prospect just south of it. The Anaconda Co. has the Pyrola Group about 6 miles south of the Greens Creek deposit, and WGM Inc., and some associates have several prospects west of Gambier and Pybus Bays. Almost 1,000 claims have been located along a similar trend on Kupreanof Island to the south of Admiralty Island and west of Petersburg. Locators included Amoco Minerals Co., Mapco,and Resource Associates of Alaska. Geologic work and some drilling was done during 1978 and 1979. BP Alaska Exploration, Inc., explored a group of claims on Zarembo, the next island south of Kupreanof.

The Riverside mine, north of Hyder, was examined and sampled by Nor-Quest Resources.Workings below the mill adit level were pumped out for the first time since 1927. The mine has produced lead, zinc, silver, gold, and tungsten.

Molybdenum.—U.S. Borax & Chemical Corp. has been developing a world-class molybdenite deposit at Quartz Hill, about 45 miles east of Ketchikan. After the end of the 1979 field season, U.S. Borax reported that since discovery in 1974, it has drilled 100,000 feet of core hole which indicated in-place reserves of 1.3 billion tons grading 0.13% molybdenite at 0.05% cutoff. This is equivalent to 2 billion pounds of contained molybdenum and is a 20% increase in the estimated in-place reserves over that reported at the end of 1978. U.S. Borax has invested $14.5 million in its Quartz Hill project to date. The proposed budget for 1980 is over $5 million. A major portion of the budget will be for continuation of the environmental baseline data gathering programs. Access road construction has not been permitted, so all transport to and from the Quartz Hill project to tidewater has been by helicopter. The project is within the Misty Fiords National Monument, created on December 5, 1978.

AMAX Exploration, Inc., drilled a molybdenum occurence and some base-metal sulfide deposits in the Groundhog Basin area east of Wrangell.

A molybdenum property on Mount Ogden, on the Alaska-Canada boundary, was discovered in 1978. It is about 45 miles east of Juneau. Geologic mapping and surface sampling were followed by diamond drilling and some underground work in 1979 on the Canadian side of the located area. Bema Industries Ltd. reported discovery and initial testing of the Y-zone molybdenum deposit in 1979 after tracing float up the Wright Glacier, which is in Alaska, west of the Boundary ridge.

Nickel and Cobalt.—Inspiration Development Co. did geologic work and diamond drilling in 1978 and 1979 on its groups of unpatented nickel-cobalt-copper claims on Yakobi Island and at Mirror Harbor, on Flemming and Chichagof Islands. There was no reported activity at the Nunatak Group of patented claims near Brady Glacier, located in Glacier Bay National Monument.

Silver.—Industry and DG&GS sources estimate about 6,500 troy ounces of silver was produced as an alloy with placer gold. An unknown quantity of silver was shipped in ore by the Berry Brothers from a silver lode mine in the Wrangell Mountains.

The Greens Creek prospect on Admiralty Island may become the first major silver mine in Alaska. It was discovered in 1975 and explored by diamond drill holes from surface stations. After concluding surface drilling, the data released by Noranda Exploration, Inc., the operating partner, indicated about a million tons of reserves averaging 10.4% zinc, 3.29% lead, 0.4% copper, 0.13 troy ounce of gold per ton, and 9.40 troy ounces of silver per ton. The 1978-79 program included driving about 4,500 feet of 10- by 12-foot adit in the hanging wall parallel to the deposit, cutting drill stations every 150 feet opposite the deposit, and drilling a fan of holes at each station. This drilling totaled about 20,000 feet. The reserve tonnage and the average silver grade were both increased significantly by this exploration. The property is owned by the Pan Sound Joint Venture. The venturers are Noranda Exploration, Inc., Marietta Resources International, Texas Gas Exploration, Inc., Mitsubishi Corp., and Bristol Bay Native Corp.

Tin.—Lost River Mining operated a tin placer washing plant on Cape Creek and produced cassiterite concentrates. Lee Bros. Dredging Co., Inc., produced some concentrates in the same general area on the Seward Peninsula. Several tons of tin concentrate was recovered as a coproduct at the Miller-Neubauer gold placer near Tofty, about 100 miles west of Fairbanks.

Tungsten.—Tungsten concentrates were recovered by the small mill at the Yellow Pup mine. The mine is on Gilmore Dome, about 15 miles northeast of Fairbanks.

NONMETALS

Asbestos.—Drilling and other exploration projects were conducted on the Eagle Asbestos prospect by Alaska Asbestos Co. This company is reported to be a partnership owned equally by Tanana Asbestos Corp., MacIntyre Mines Ltd., and General Crude Oil Co. Tanana Asbestos Corp. is a wholly owned subsidiary of Doyon, Ltd., an Alaska Native Corp. The prospect is on Doyon, Ltd., land north of Tok. Drilling is said to have confirmed the occurrence of fiber-bearing ultrabasic rocks extending about 1,200 feet on strike and 1,000 feet down dip.

ASARCO Incorporated and Canadian Superior Exploration Ltd., are active in the Eagle area on an asbestos program.

Barite.—Production of crude ore was resumed in 1979 at the Castle Island deposit of Chromalloy American Corp., in Duncan Canal, east of Petersburg. The barite was shipped to an outside processor.

The Lime Point deposit is again of interest. Adjoining land and offshore claims have been located and recorded. The property is on the east shore of Hetta Inlet, Prince of Wales Island, about 45 miles southeast of Ketchikan.

The Anaconda Co. is exploring the base-metals-and-barite deposit of Alyu Mining Co. The deposit is north of Jarvis Creek, about 40 miles northwest of Haines.

Barite is a prominent mineral in some of the stratiform and related zinc-lead deposits in the western part of the Brooks Range and has been found as the dominant mineral at several mineralized areas.

Gem Stones.—Most of the reported gem stone production consists of jade and soapstone. The jade is usually collected in the

Jade Mountain area and barged westerly down the Kobuk River to Kotzebue. Part of the jade is used there in Native handicrafts; the balance is shipped to other domestic or foreign destinations. Most of the soapstone is produced and marketed by the Hill family of Palmer, which mines it near the head of Grubstake Gulch in the Talkeetna Mountains.

Gypsum.—Domtar, Inc., a Canadian company, acquired the old Pacific Coast gypsum mine when it purchased the gypsum assets of Kaiser Cement and Gypsum Corp. Domtar has located a block of new claims adjoining the patented claims of the old mine. This property is on the east coast of Chichagof Island, about 35 miles southwest of Juneau.

Sand and Gravel.—Sand and gravel production reported in 1978 totaled 69.3 million short tons; in 1979, reported production was 50.9 million short tons. All of the sand and gravel produced in 1978 and 1979 was classed as construction aggregate. Principal uses of the total aggregate reported in the biennium were as follows: fill, 78% in 1978 and 88% in 1979; concrete aggregate, 11% in 1978 and 8% in 1979; roadbase and coverings, 4% in 1978 and 3% in 1979;and asphaltic concrete, 5% in 1978 and 1% in 1979.

Table 5.—Alaska: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	7,217	$34,734	$4.81	7,960	$40,113	$5.04	4,161	$20,457	$4.92
Plaster and gunite sands	NA	NA	NA	W	W	W	W	W	W
Concrete products	77	309	4.00	W	W	W	W	W	W
Asphaltic concrete	3,205	12,499	3.90	3,748	14,948	3.99	392	1,676	4.28
Roadbase and coverings	2,605	6,718	2.58	2,863	7,538	2.63	1,422	3,701	2.60
Fill	53,113	79,571	1.50	54,253	81,373	1.50	44,596	78,004	1.75
Snow and ice control	NA	NA	NA	334	W	W	W	W	W
Other uses	209	423	2.02	30	40	1.34	82	267	3.24
Total[1] or average	66,426	134.251	2.02	69,300	145,300	2.10	50,900	104,905	2.06

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Data may not add to totals shown because of independent rounding.

Table 6.—Alaska: Construction sand and gravel sold or used by producers

	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	59,421	$119,655	$2.01	63,143	$131,215	$2.08	45,551	$91,845	$2.02
Gravel	7,005	14,595	2.08	6,152	14,057	2.29	5,349	13,060	2.44
Total[1] or average	66,426	134,251	2.02	69,300	145,300	2.10	50,900	104,905	2.06

[1]Data may not add to totals shown because of independent rounding.

Stone.—All of the stone reported produced in 1978 and 1979 was crushed stone. No dimension stone was reported. The principal uses reported in 1979 were unspecified aggregate (86.5%), dense roadbase (10.4%), surface treatment (0.9%), agricultural limestone (0.8%) and rip rap and jetty (0.6%).

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[1]State mineral specialist, Bureau of Mines, Juneau, Alaska.

Table 7.—Alaska: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	--	--	--	--	28	142
Concrete aggregate	7	93	7	93	W	W
Bituminous aggregate	533	1,539	23	42	W	W
Dense-graded roadbase stone	3,309	15,487	3,240	13,994	379	1,456
Surface treatment aggregate	4	57	4	57	32	121
Other construction aggregate and roadstone	8	19	--	--	3,163	13,479
Riprap and jetty stone	77	156	116	232	23	50
Railroad ballast	70	143	3	12	--	--
Manufactured fine aggregate (stone sand)	--	--	43	217	--	--
Fill	--	--	2	--	17	68
Other uses[2]	--	--	--	--	13	142
Total[3]	4,008	17,493	3,437	14,649	3,656	15,458

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, traprock, and miscellaneous stone.

[2] Includes stone used for terrazzo and exposed aggregate (1979), and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 8.— Principal producers

Commodity and company	Address	Type of activity	Region
Barite:			
Chromalloy American Corp	Box 650 Petersburg, AK 99833	Open pit	Southeastern Alaska.
Gold:			
Bliss and Sons	129 East 11th Ave. Anchorage, AK 99501	Placer-dredge	Northwestern Alaska.
Engstrom and Son Dredging Co	Box 536 Nome, AK 99762	do	Seward Peninsula.
Heflinger Mining and Equipment Co	409 Clara St. Fairbanks, AK 99701	Placer	Yukon River.
Little Squaw Gold Mining Co	Box 184 Spokane, WA. 99210	Lode Placer	Do.
Marvel Creek Mining Co	Nyak, AK 99642	Placer-dredge	Kuskokwim River.
Miscovich Mining Co	Box 23 McGrath, AK 99627	Hydraulic	Do.
Peters Creek Mines	700 Ash Pl. Anchorage, AK 99501	Placer	Cook Inlet-Susitna.
Alaska Gold Co	437 Madison Ave. New York, NY 10022	Placer-dredge	Seward Peninsula.
Asamera Oil (U.S.), Inc	Box 118 Denver, CO 80201	Placer	Yukon River.
Ruby Mining Co	Box 1 Ruby, AK 99768	do	Do.
G. A. Hanks and Sons	Chicken, AK 99732	do	Do.
Candle Creek Placers	Candle Creek, AK 99728	do	Do.
Flat Creek Placers	Flat Creek, AK 99584	do	Do.
Sand and gravel:			
Alaska Brick Co	7800 Lake Otis Rd. Anchorage, AK 99507	Pit	Cook Inlet-Susitna.
Alaska Sand and Gravel, Inc	University Ave. Fairbanks, AK 99707	Pit	Yukon River.
Anchorage Sand and Gravel	1813 East 1st Ave. Anchorage, AK 99501	Pit	Cook Inlet-Susitna.
Castle Construction Co	8121 Sand Lake Rd. Anchorage, AK 99502	Pit	Do.
Central Construction Co., Inc	428-117 2d Ave. Seattle, WA 98101	Pit	Northwestern Alaska.
Green Associated	Pouch 85 Fairbanks, AK 99707	Pit	Southeastern Alaska.
Rogers and Babler Inc	4607 East Tudor Rd. Anchorage, AK 99507	Pit	Cook Inlet-Susitna.
Energy Co. of Alaska	do	Pit	Do.
Fairbanks Sand and Gravel Inc	2 1/2 Mile Richardson Highway Fairbanks, AK 99707	Pit	Yukon River.
Alaska Aggregate Corp	7800 Lake Otis Parkway Anchorage, AK 99507	Pit	Cook Inlet-Susitna.
Stone:			
Burgess Construction Co	394 Hamilton Fairbanks, AK 99707	Quarry	Yukon River and Southeastern Alaska.
Ketchikan Pulp Co	Box 11619 Ketchikan, AK 99901	do	Southeastern Alaska.

Table 8.— Principal producers —Continued

Commodity and company	Address	Type of activity	Region
Stone —Continued			
Olsen and Sons Logging Ltd	Box 950 Petersburg, AK 99833	Quarry	Southeastern Alaska.
Yutan Construction Co	Box 1775 Fairbanks, AK 99707	do	Yukon River.
Moore Construction Co. Inc	Box 8100 Ketchikan, AK 99901	do	Southeastern Alaska.
Soderberg Logging and Construction Co.	Box 400 Kake, AK 99830	do	Do.
Welborn Construction, Inc	Box 634 Kodiak, AK 99615	do	Kodiak.
Tin:			
Lee Bros. Dredging Co., Inc	Box 816 Nome, AK 99762	Dredge	Seward Peninsula.
Lost River Mining	Box 411 Nome, AK 99762	Placer	Do.
Miller and Neubauer	Manley Hot Springs, AK 99756	do	Yukon River.

The Mineral Industry of Arizona

This chapter was prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Arizona Bureau of Mines for collecting information on all nonfuel minerals.

By Lorraine B. Burgin[1]

The value of Arizona nonfuel mineral production reached $1.7 billion in 1978 and an alltime high of almost $2.5 billion in 1979. The State was ranked second in the Nation for nonfuel mineral production in 1978 and first in 1979.

Metal production, $1.5 billion in 1978, climbed to over $2.2 billion in 1979, about 91% of the total value of nonfuel mineral production in the State. After the copper strikes of 1977, copper production recovered to $1.3 billion in 1978 and rose to over $1.9

Table 1.—Nonfuel mineral production in Arizona[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clay thousand short tons	[2]33	[2]$444	143	$731	138	$642
Copper (recoverable content of ores, etc.) metric tons	838,028	1,234,168	891,405	1,306,866	946,002	1,940,211
Gem stones	NA	4,500	NA	4,600	NA	4,000
Gold (recoverable content of ores, etc.) troy ounces	90,167	13,373	92,989	17,998	101,840	31,316
Gypsum thousand short tons	187	775	184	955	231	1,245
Lead (recoverable content of ores, etc.) metric tons	288	195	416	309	354	411
Lime thousand short tons	474	15,528	498	19,743	673	27,186
Molybdenum (content of concentrate) thousand pounds	34,574	120,497	W	W	35,101	213,065
Pumice thousand short tons	621	1,226	1,135	3,130	940	2,367
Sand and gravel do	22,313	49,946	28,314	69,096	[3]30,520	[3]74,716
Silver (recoverable content of ores, etc.) thousand troy ounces	6,828	31,546	6,638	35,844	7,479	82,941
Stone:						
Crushed thousand short tons	5,359	16,367	5,306	17,669	5,769	21,401
Dimension do	8	128	5	101	5	110
Zinc (recoverable content of ores, etc.) metric tons	3,973	3,013	W	W	W	W
Combined value of asbestos, cement, clays (ball clay, common clay, and fire clay, 1977), feldspar (1977-78), fluorspar, mica (crude, 1977), perlite, pyrites, salt, sand and gravel (industrial, 1979), tungsten, and values indicated by symbol W	XX	63,082	XX	227,586	XX	90,870
Total	XX	1,554,788	XX	1,704,628	XX	2,490,481

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes ball clay, common clay and fire clay; value included in "Combined value" figure.

[3] Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Arizona, by county

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Apache	W	$2,315	Pumice, sand and gravel, clays, stone.
Cochise	$24,141	20,932	Copper, lime, stone, sand and gravel, silver, gold, lead, zinc.
Coconino	W	W	Pumice, sand and gravel, stone.
Gila	141,722	175,340	Copper, molybdenum, silver, gold, sand and gravel stone, lime, asbestos, fluorspar, clays.
Graham	W	W	Sand and gravel, copper, pumice.
Greenlee	W	264,204	Copper, silver, gold, lime, stone, sand and gravel.
Maricopa	W	W	Sand and gravel, lime, salt, stone, clays.
Mohave	38,053	46,515	Molybdenum, copper, sand and gravel, stone, silver, feldspar.
Navajo	2,815	3,294	Sand and gravel, pumice, stone.
Pima	629,607	595,005	Copper, molybdenum, cement, silver, sand and gravel, stone, gold, lead, clays, zinc, tungsten.
Pinal	390,180	393,127	Copper, molybdenum, gold, silver, stone, sand and gravel, lime, gypsum, perlite, lead, pyrites, clays.
Santa Cruz	629	1,457	Sand and gravel.
Yavapai	76,600	148,293	Copper, cement, molybdenum, lime, stone, silver, sand and gravel, gold, gypsum, clays.
Yuma	W	W	Sand and gravel, tungsten.
Undistributed[1]	251,039	54,144	
Total[2]	1,554,788	1,704,628	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes value of mineral production that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Arizona business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	978.0	1,000.0	1,052.0	+5.2
Unemployment	do	80.0	61.0	53.0	-13.1
Employment (nonagricultural):					
Mining[1]	do	21.5	19.4	21.6	+11.3
Manufacturing	do	113.9	126.9	142.4	+12.2
Contract construction	do	52.2	71.0	82.7	+16.5
Transportation and public utilities	do	41.5	44.6	48.4	+8.5
Wholesale and retail trade	do	196.5	215.4	234.3	+8.8
Finance, insurance, real estate	do	45.6	50.2	54.5	+8.6
Services	do	156.2	173.1	189.5	+9.5
Government	do	181.9	194.8	197.5	+1.4
Total nonagricultural employment[1]	do	809.3	895.4	970.9	+8.4
Personal income:					
Total	millions	$14,914.0	$17,383.0	$20,347.0	+17.1
Per capita		$6,471.0	$7,385.0	$8,305.0	+12.5
Construction activity:					
Number of private and public residential units authorized		41,913.0	[2]62,145.0	53,761.0	-13.5
Value of nonresidential construction	millions	$314.0	$474.6	$718.9	+51.5
Value of State road contract awards	do	$140.0	$115.0	$130.0	+13.0
Shipments of portland cement to and within the State	thousand short tons	1,477.0	1,617.0	1,808.0	+11.8
Nonfuel mineral production value:					
Total crude mineral value	millions	$1,554.8	$1,704.6	$2,490.5	+46.1
Value per capita, resident population		$675.0	$724.0	$1,017.0	+40.5
Value per square mile		$13,649.0	$14,965.0	$21,864.0	+46.1

[p] Preliminary.

[1] Includes bituminous coal and oil and gas extraction.

[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

billion in 1979, achieving over three-fourths of metal output in the State and ranking first in the Nation for both years.

The increase in the value of Arizona's mined metal output is attributed not only to the rise in the price of copper but also to the dramatic rise in the price of the byproduct metals recovered from the copper ores. Again, in 1978 and 1979, production of those byproduct metals made Arizona the second largest producer of molybdenum and silver and the fourth largest producer of gold. Arizona produced just over 65% of the Nation's copper during the biennium.

Sand and gravel, portland cement, lime, and crushed stone were the leading commodities in the nonmetals group in 1978 and 1979. In 1979, decreases were posted both in amount and value for the production of pumice, clay and shale, perlite, asbestos, and fluorspar.

Trends and Developments.—At the beginning of 1978, copper prices were near the bottom of a price cycle that had been in a general downtrend for several years. Copper markets were depressed, production curtailed, costs escalating, and labor disputes interrupting operations. Several large mines had curtailed operations, and some producing and developing operations had been suspended. This situation began to change during 1978 as copper consumption increased; and by yearend, significantly reduced world stocks generated an upward trend in prices. Prices of molybdenum, silver, and gold also were climbing dramatically.

Output of most major mineral commodities in Arizona continued to trend upward during 1978-79.

The prevailing and persistent trend in Arizona in recent years has been an expanding and diversifying minerals industry, from exploring to fabrication of various metal products. Although copper still predominated in 1978-79, other mineral discoveries, new mines, enlarged facilities, evolving technologies, and changing economics steadily increased the capacities and variety of Arizona's minerals industry. The State's mineral production in the decade 1967-77 increased 240% in value to reach $1.7 billion in 1978, and then again reached an alltime high of nearly $2.5 billion in 1979.

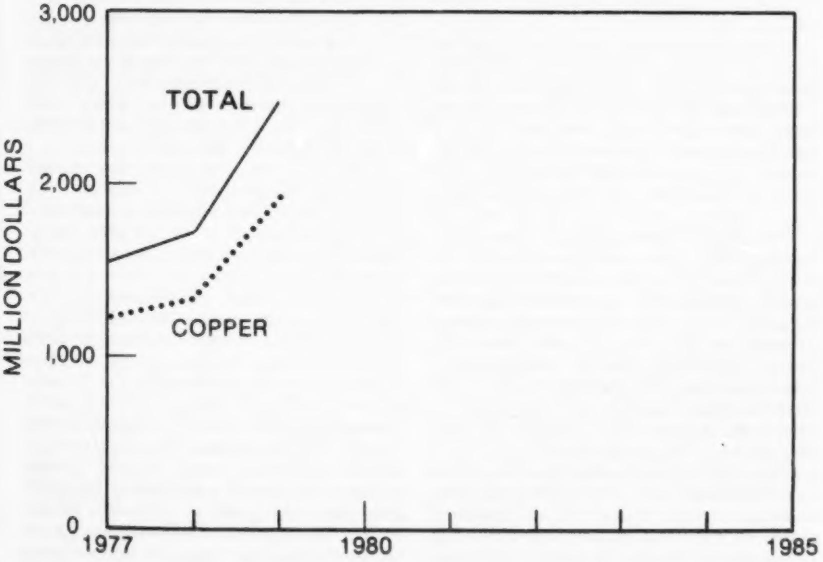

Figure 1.—Value of mine production of copper and total value of nonfuel mineral production in Arizona.

As examination and evaluation of most exposed mineral occurrences in the State were completed, exploration was directed toward searching for concealed deposits with targets indicated by geologic interpretation and extrapolation. In recent years, discovery of several deposits, principally copper, was adding to the total reserves and potential for Arizona.

New discoveries and ongoing investigations kept open the likelihood that Arizona's minerals industry will continue to expand and diversify. Confirmed as a major mineralized area, copper occurrences north of Safford in the Gila Mountains of Graham County were being investigated and developed. Also considered for development were major copper deposits near Florence in Pinal County, north of Prescott in Yavapai County, near Patagonia in Santa Cruz County, and in the Santa Rita Mountains south of Tucson. Most recently, a large buried copper deposit was found west of Casa Grande in Pinal County for which no plans have yet been announced. A potash deposit east of the Petrified Forest in Apache County has been investigated. Zeolite, barite, fluorspar, feldspar, mica, and limestone occurrences also were being studied for their minability and market potential.

Indian reservations, occupying over one-fourth of Arizona, contain vast and varied mineral resources. The evolving role of Indians and the changing situations on their reservations are a pronounced and significant trend in Arizona, presenting numerous complex issues directly related to the effect of minerals on the State's economy.

The Navajo Nation, which (with the smaller Hopi Reservation) encompasses much of the northeast quadrant of Arizona, contains much of the State's known coal, oil, and gas reserves as well as other mineral resources. The Navajo Tribal Chairman, declaring the tribe's goal of "independence and sovereignty," has offered to "share the tribe's mineral wealth," with the State in return for better medical facilities, more educational opportunities, and improved roads on the giant reservation. Sometimes in collaboration with other tribes, the Navajos are moving to establish full control of their mineral resources and to promote full development of those resources and gain full benefit. Other Indian tribes in Arizona are taking positive steps to evaluate their mineral resources and prepare plans for wise development. This activity has produced some controversy and numerous legal actions.

Land-use planning, largely by Federal agencies, increasingly constrained entry for mineral exploration or development in ever-expanding acreage of the State. The U.S. Forest Service and the U.S. Bureau of Land Management implemented new legislative mandates, initiated inventories of "roadless" areas, and promulgated more regulations on use of Federally controlled lands.

The effects of the Forest Service's Roadless Area Review and Evaluation Program (RARE II) study and Bureau of Land Management's wilderness inventory were being vigorously debated; generally acknowledged is that such continuing land withdrawal from mineral-related entry would profoundly influence trends and development of mineral-resource activities in the West. The situation was further complicated by the so-called "Sagebrush Rebellion," with the objective of putting public lands under control of the States.

In the past few years, oil companies have acquired a substantial interest in the State's minerals (especially copper) industry. Although the competition aspects of this direction have been questioned, the trend may bring more financial stability to the struggling copper industry through capital infusion. Such underpinning may also permit the copper industry to weather the cyclical nature of the industry and compete in the international marketplace.

Manifested by the numerous urgent studies and plans, legal and legislative actions, and intensified efforts to conserve and add to the supply of water, the struggle for water in Arizona is growing in intensity and complexity.

Legislation and Government Programs.—Focusing on land rehabilitation of open pit copper mining acitvity, the Committee on Surface Mining and Reclamation (COSMAR) of the National Research Council conducted a workshop and hearing in Tucson, July 6-8, 1978. The Surface Mining Control and Reclamation Act of 1977, which imposed Federal control on coal mining, required a study of reclamation standards and effects of regulation on surface mining of noncoal minerals. COSMAR was to use the information developed at the workshop to formulate specific legislative recommendations.

The U.S. International Trade Commission

held 3 days of hearings in Tucson, May 22-24, 1978, to help decide whether copper imports were injuring the domestic industry. Several major domestic copper producers had petitioned for relief under provisions of the Trade Act of 1974. These companies claimed that increasing imports of foreign copper in recent years were damaging the domestic industry. After presenting detailed evidence, the petitioners asked for imposition of import quotas on refined copper. Major copper producers in Chile, Peru, Zaire, Zambia, and Canada disputed the claims of U.S. producers and opposed the quota request. Subsequently finding in favor of the petitioners, the Commission recommended import quotas on copper. The President rejected the Commission recommendation that refined copper imports be restricted for several reasons, including that import restrictions would be inflationary and contrary to U.S. efforts to reduce trade barriers.

Bureau of Land Management took steps to implement provisions of the Federal Land Policy and Management Act of 1976 (FLPMA) by composing a Wilderness Policy and Review Procedure for identifying and inventorying those public lands under the jurisdiction of the Bureau of Land Management that meet the criteria of the Wilderness Preservation Act of 1964 for possible designation as "wilderness." This draft procedure was presented for public review, and a series of public hearings was held.

The Forest Service initiated an inventory of "roadless and undeveloped" areas in lands under its jurisdiction. About 1.8 million acres of land in Arizona were designated for possible inclusion in RARE II.

Congress was considering proposals to purchase copper for the National Strategic Stockpile. Such purchases were being proposed to reduce the price-depressing effect of large copper stocks held worldwide and, of course, to help achieve the newly established stockpile goals. At the end of 1979, stockpile purchases had not yet been approved or scheduled.

The Mining Law of 1872 played a large part in developing the minerals industry of Arizona and in the economy of the State. Heavily debated in Arizona were various legislative proposals to revise the Mining Law of 1872. Bills in Congress, which seek to repeal the present mining law and replace it with a leasing system, met mixed reactions.

The Navajo Environmental Protection Commission and the Navajo Tax Commission began implementing and enforcing a system of penalties imposed by the Navajo Tribal Council on industries on the reservation that discharge sulfur to the atmosphere. New tribal legislation provides that every plant discharging more than 100 pounds of sulfur into the atmosphere annually must have a permit from the tribe and pay a fee for each pound of sulfur discharged. This new law was first tested on a coal-burning electric-generation plant. The action raised legal questions regarding the tribe's authority to impose such taxes, but earliest court decisions were in the tribe's favor.

Governor Babbitt (who took office in 1978) vetoed Arizona legislation that would have reduced the transactions-privilege tax on sales of mineral products from 2.5% down to 1.5% for 2 years, with the explanation that the "industry may not need the second year of relief." However, the Governor subsequently signed similar legislation that reduced the tax by 0.5 of 1% for 2 years. Some observers viewed the measure as finally passed as "more of a message than a relief" to the Arizona copper crisis.

Environment.—New technology requirements and rising capital expenditures have made environmental protection and enhancement more difficult, complex, and expensive. Arizona's copper industry has spent an estimated $500 million to reach compliance with air quality standards. However, copper smelters continue to be troubled by the economic and technologic factors involved in State air quality standards, anticipated Federal environmental actions, and the uncertainties and conflicts between these regulating agencies. Arizona's mines have been increasingly involved in waste disposal problems, including water quality and dust control. Aesthetic factors, for example waste piles at copper open pits, are becoming sensitive issues, difficult and expensive to resolve.

Proliferation of environmental regulations is profoundly affecting Arizona's mineral industry. The longstanding and still unresolved question of who administers air quality plans and standards (simply stated, do the smelters operate under State regulations and permits or under Federal regulations and permits) has created what has been described as a critical situation. Hearings have been held on how to eliminate this impasse between State and Federal agencies.

Arizona established its first smelter regulations in 1970, requiring that smelters emit no more than 10% of the sulfur fed into them in ore and mineral concentrates. Only two smelters in the State met that requirement, and it was dropped in 1972. The rules have been revised several times, and new emission regulations were established in 1977; however, there was some doubt that any of the State's smelters could comply. Throughout 1978, the U.S. Environmental Protection Agency (EPA) and the State of Arizona were trying to reach an understanding so that smelters could comply with State standards. During October 1978, the Arizona Department of Health Services held public hearings as a step toward adoption of new rules and regulations for control of air pollution. This controversy had not yet been resolved by the end of 1979.

In 1977, then-Governor Castro urged the Commission on the Arizona Environment to "search for balance" in environmental issues. He pointed out that "Arizona has no comprehensive environmental policy," and called for a State Energy Agency, established a Citizens' Energy Task Force and an Interagency Planning Office, and presented an Arizona Energy Policy and Conservation Program. Governor Babbitt, in 1978, asked the Commission on the Arizona Environment to continue proposing recommendations on environmental issues for gubernatorial action or legislation.

Water.—Availability of water is one of the most ramified, urgent, and vexing problems in Arizona. Water control, quality, supply-demand, and disposal continue to plague not only the minerals industry but also other economic sectors and societal groups in the State. Water may become an even more critical problem for the State and its minerals industry.

Indian tribes across Arizona were involved in negotiations and litigations claiming water rights and damage under various legal decisions that imply tribal rights to off-reservation water. The implications of these claims and related legal struggles for the minerals industry have yet to be determined.

In a lawsuit by an agricultural organization, the Arizona Supreme Court ruled that transfer of pumped groundwater from one "parcel" of land to another in critical groundwater basins of the State was illegal under existing law. This decision jeopardized the water supply of many large mines in Arizona and in the City of Tucson. The Legislature then passed emergency legislation permitting continued temporary pumping of groundwater. It also provided for a 25-member Groundwater Management Study Commission to review the State's groundwater laws and to make recommendations on constitutional and statutory changes. The Commission's recommendations are to become law automatically in 1981, even if the Legislature fails to act on its report; the constitutionality of this provision has already been challenged.

The Arizona Water Commission has undertaken a comprehensive long-range water plan. Phase I of the Arizona State Water Plan, published in July 1975, was a comprehensive inventory of water resources and uses in the State. Published in 1977, Phase II of the plan presented the alternatives for development and use of Arizona's water. Various factors influencing water supplies and uses are translated to estimates of alternative levels of water use for the next 50 years. Because of the size and importance of the minerals industry in Arizona and the considerable influence the industry has on water-planning efforts, alternate levels of water use by the minerals industry were separated and projected in the study.

In June 1978, the Arizona Water Commission published the first of three installments on Phase III (final phase) of its exhaustive study of water in Arizona. Phase III is what the Legislature has said it has been waiting for, namely, recommended answers for prolonging and equalizing the State's water supplies. The first installment deals with conservation efforts and what they can achieve. Additional installments of Phase III will address the effects and consequences of recommended water-conservation plans, the potential for augmenting Arizona's water supply, various resource-management programs that might be implemented, and the impacts of these programs.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Copper.—Copper represented 77% of the value of nonfuel mineral production in Arizona in 1978, and 78% of the value in 1979.

The Anamax Mining Co., in an equal partnership between AMAX, Inc., and the Anaconda Co., operated the Twin Buttes open pit copper mine about 25 miles south of Tucson, Pima County. The partnership covered only mining and concentrating the copper sulfide ore. Each company was responsible for smelting, refining, and marketing the product. Beginning in 1979, most of AMAX's share of copper concentrates from Twin Buttes was sold to Nippon Mining Co., Ltd., of Japan. The partnership is involved with the copper oxide operation through the production of electrowon cathode copper, then each partner buys and markets its portion.

According to the AMAX 1979 annual report, ore reserves in the Twin Buttes deposit were estimated to be 313 million tons of sulfide ore with an average grade of 0.66% copper and approximately 44 million tons of oxide ore with an average grade of 0.99% copper. Sulfide ores were treated at the sulfide concentrator, and oxide ores were processed in a leaching and electrowinning plant. The company attributed the increased production of copper concentrate at Twin Buttes in 1979 to (1) higher ore production and productivity at the mine, (2) bringing the operating rate of the sulfide mill up to design capacity (40,000 tons per day) in July, and (3) the higher mill recovery and (4) initial delivery of ore from the Eisenhower Mining Co. Byproducts included molybdenum and silver recovered from the sulfide ore; beginning in 1980, uranium is to be recovered from the oxide ore.

In 1979, Anamax installed a plant to recover about 141,000 pounds of uranium concentrate per year from the copper oxide ores. The $10 million plant was scheduled for startup early in 1980.

In other developments—October of 1979, the Federal Trade Commission ruled the acquisition of the Anaconda Co. by Atlantic Richfield Co. on January 22, 1977, represented a violation of antitrust laws. Anaconda was allowed 5 years to divest itself of several copper properties including its major interest in Anamax Mining Co.

The Eisenhower Mining Co., a partnership of ASARCO Incorporated, and Anamax Mining Co., brought the Palo Verde copper deposit onstream January 9, 1979. Development of the property located between Asarco's Mission and South San Xavier open pit mines 20 miles south of Tucson, has been underway since 1976. According to Skillings[2], the Palo Verde Property, held by Anamax under State of Arizona leases, contains 125 million tons of ore averaging 0.6% copper. Asarco contributed portions of the State of Arizona leases, known as the Golden West claims, adjoining Palo Verde on the south and containing 31.1 million tons of 0.7% copper. The reserves of the partnership total 156.1 million tons with an estimated life of 25 years at the initial rate of production. Mining of the deposit under the joint-venture agreement is expected to reduce operating costs greatly for both companies and to lengthen the life of the Mission-San Xavier Mine significantly by eliminating pit slopes and recovering ore that would ordinarily have to be left along property lines. Asarco operates the mine and processes its portion of the ore, 12,000 tons per day, at the Mission concentrator. Anamax transports its portion, 14,000 tons per day, over a new 6-1/2-mile conveyor to the Twin Buttes plant for processing. The new operation and the multimillion-dollar Anamax Eisenhower system including the primary crusher, overland conveyor, and sampling plant were described in 1979[3].

Asarco operates four open pit copper mines in Arizona: the Mission, the San Xavier, and the Silver Bell, all near Tucson in Pima County; and the Sacaton near Casa Grande, Pinal County. Ores are processed through concentrators at the mine sites. Full production was resumed at the Mission, San Xavier, and Silver Bell mines in February 1978, after the 1977 10-week strike, followed by a 7-week shutdown because of weak markets and prices. In 1979, however, production at the Mission and San Xavier Mines was reduced to accommodate processing the Eisenhower ores at the Mission concentrator.

In a major modernization and expansion effort, a $22 million program was instituted at the Mission Mine in 1979. Plans were to replace the truck fleet with new 170-ton trucks that were expected to consume 12-1/2% less fuel, and to install large-volume flotation cells in the mill. These flotation units were expected to increase recovery of copper and decrease power cost by 25%. The vat-leaching operation at the Mission Mine was operated from February to November 1978, then shut down when the supply of San Xavier oxide ore was exhausted. Engineering plans were completed to modify the plant to treat the underlying sulfide ores when economically feasible.

Because of high molybdenum prices, the byproduct plant at Silver Bell was reactivated in September 1978, to recover molybdenum from copper ore; and in 1979, the company mined ores at Mission and San

Xavier with an above average molybdenum content.

The Sacaton open pit operation about 6 miles northwest of Casa Grande increased production in 1978 and 1979 to normal levels. At the Sacaton underground operation, the main shaft being sunk to develop a deeper ore body east of the pit reached a depth of 1,475 feet when excess water halted the advance in April 1978. A means of controlling the groundwater was devised and the project rescheduled; however, work had not resumed by yearend 1979.

The Cities Service Co. Pinto Valley mine about 6 miles west of Miami, Gila County, produced a record 162 million pounds of copper in 1978 and 155 million pounds of copper in 1979. The company attributed the decrease in 1979 to a slight decline in grade. Molybdenum recovery was reported at a new high. The average rate of mine and mill production in 1979 was 47,500 tons of ore feed per day, 19% over original design capacity (40,000 tons per day). Copper is also leached from a discontinued mine. A solvent extraction-electrowinning facility is maintaining a design capacity of about 1 million tons of cathode copper per month.

In early 1978, construction of the No. 4 tailings disposal area was completed. The tailings dam and retention pond area with a capacity of more than 234 million tons cover approximately 522 acres. Requiring almost 2 years to construct, the facility is expected to last more than 22 years. Sixty percent of the water is recovered from the tailings pond and is returned to the mill. Although the facilities are located away from public view, the area will be revegetated as the site becomes inactive.

Other significant reclamation activities noted were the Mondell pine trees planted in 1978 on the old Copper Cities tailings area. A successful vegetative stabilization project was noted at the 460-acre tailings disposal dam for the old Miami Copper Co. mill at Solitude, where trees have grown from 12 to 20 feet high.

With the improved price of copper, the company, in September 1979, announced that development of the Miami East underground mine will be resumed and completed by 1982. The project, begun in 1969, had been on standby maintenance since 1975 because of a severe drop in copper prices. By 1982, a second solvent-extraction and electrowinning plant will be constructed at the Pinto Valley mine to process leach solutions from waste dumps. Estimated to cost $40 million, the two projects are expected to add approximately 30 million pounds of copper per year to the company's productive capacity.

On September 21, 1979, Cyprus Mines Corp. was merged into Amoco CYM Corp., a wholly owned subsidiary of Standard Oil Co. (Indiana). After the merger, Amoco CYM Corp. changed its name to Cyprus Mines Corp. According to the 1979 Standard Oil annual report, the cost was $117 million cash and 5.1 million shares of Standard stock. Cyprus operations in Arizona include the Bagdad open pit copper mine 120 miles northwest of Phoenix in Yavapai County, the Johnson open pit copper mine 65 miles east of Tucson in Cochise County, the Bruce underground mine near Bagdad in Yavapai County, and the Pima open pit copper mine in Pima County.

The Cyprus Bagdad Mining Co. (Bagdad) operations include the open pit mine, a 40,000-ton-per-day sulfide ore concentrator, an oxide-ore-dump leaching system with a solvent-extraction electrowinning plant. The company also provides housing, a shopping center, a hospital, schools, and other facilities for its employees. Expansion of its open pit mine, construction of the sulfide concentrator, and housing for employees commenced in 1974 and cost over $220 million before the project was completed in late 1977.[4] In 1978, copper production increased from 46.3 million pounds to 131.1 million pounds, sales of molybdenum from 0.3 million to 2.5 million pounds, and sales of silver from 56,000 ounces to 308,000 ounces. As of December 31, 1979, Cyprus Bagdad estimated sulfide ore reserves were about 316 million tons averaging 0.49% copper. As of December 31, 1978, overlying oxide reserves were estimated at 20 million tons with an acid-soluble copper content of 0.37%. Also, approximately 97 million tons of oxide ore with an acid-soluble copper content of approximately 0.19% had been stockpiled from previous extraction operations.

Completed in November 1978, the Cyprus Metallurgical Process demonstration plant at Tucson began operation February 1979. In 1979, the plant was operated at design capacity and successfully treated 10 tons of ore per day. Plans were being evaluated for constructing a scaled-up hydrometallurgical plant that would produce 25,000 tons of copper per year.

The Cyprus Pima Mining Co. (Pima) mine located about 25 miles south of Tucson and owned 50.01% by Cyprus Mines Corp., 24.99% by Utah International, (a division of General Electric), and 25% by Union Oil Corp., was closed September 1977 because of low copper prices. In late 1979, production was resumed at a reduced rate, about 18,500 tons per day. Before cessation of operations, the daily capacity was 55,000 tons. Contributing factors in reopening the mine were the improved copper and molybdenum prices in 1979. As of December 31, 1978, the company estimated ore reserves at the Pima mine were 147.5 million tons averaging 0.497% copper.

The Cyprus Johnson Mining Co. (Johnson) mine is 65 miles east of Tucson near Benson, Cochise County. Ore is placed on specially prepared dumps, leached with dilute sulfuric acid, and the resulting solution treated in a solvent-extraction electrowinning plant to produce a commercially pure electrowon copper cathode. As of December 31, 1978, the company estimated ore reserves were 8.9 million tons averaging 0.5% acid soluble copper.

Cyprus Bruce Mining Co. (Bruce) copper and zinc mine, a high-grade underground mine, was closed permanently July 4, 1977, because of low copper prices, resultant operating losses, and minimal ore reserves.

Duval Corp., a subsidiary of Pennzoil, Inc., operated the Sierrita and adjacent Esperanza open pit mines near Tucson in Pima County and the Mineral Park open pit mine near Kingman in Mohave County. The Sierrita mine was operated during 1978 and 1979; however, because of economic conditions, the Esperanza open pit mine was closed in October 1977, and remained shut down until March 1979.

The new $30.9 million crushing and conveying system, completed in 1977 at Sierrita and Esperanza, was described in three articles.[8] The system was installed to reduce ore-processing and haulage costs and to increase production.

The project consisted principally of two new primary crushers at the 3,600-foot level of the Sierrita pit, a 2.8-mile overland ore conveyor belt, and 1.5-mile waste-conveyor system including a stacker. With the new crushing and conveying facilities, the Esperanza and Sierrita pits will be consolidated to become one of the world's larger copper molybdenum operations.

The Mineral Park mine was operated during the 2 years; however, production dipped slightly in 1979.

The CLEAR-process hydrometallurgical plant near Sierrita uses an electrolytic process to produce copper crystals from concentrates and precipitates from Sierrita and Esperanza. The plant operated at 78% and 79% of its design capacity in 1978 and 1979, respectively.

Inspiration Consolidated Copper Co. is an integrated natural resources company with principal operations at Inspiration, Gila County. The operation consists of mines and concentrators, smelter, refinery, solvent extraction, rod fabricating, and sulfuric acid plants. In the Globe-Miami mining district, the mines include the Thornton, Live Oak, Red Hill, and Joe Bush open pit mines at Inspiration; and the upper and lower Ox Hide open pit approximately 3 miles west of Inspiration. In the Banner mining district, about 35 miles south of Globe, the company owns the Christmas open pit and underground mines.

Copper production at Inspiration area mines returned to normal levels in 1978. After the July-August 1977 copper strike, sales were made from inventories, and mining, concentrating, and vat leaching were not resumed until January 1978 because of the depressed copper prices. The smelter, however, continued to process ores from the Cities Service Pinto Valley operation on a toll basis. Copper was received from the circulation of sulfuric acid through previously mined ore in leach dumps of the Ox Hide mine; however, the open pit remained closed during 1978 and 1979. The Christmas open pit mine, which was also closed in 1977, reopened in April of 1979; the underground mine was closed in 1966. Inspiration also owns the Sanchez mine near Safford; although preliminary mining plans and metallurgical plant designs were complete, the company suspended development work in 1978.

During 1978 and 1979, various improvements were made at the Inspiration operations. A $2.5 million sulfuric acid pre-dryer concentrator was installed to convert low-strength sulfur dioxide gas from the smelter into 93% sulfuric acid, and a $14 million solvent-extraction plant for treating dump-leach solutions was completed in October 1979. The new solvent-extraction facility will eliminate the iron precipitation, smelting, and refining processes in the recovery of copper from leach solutions, and thus achieve significant savings in the cost of production. At the end of 1979, the plant was operated at 2,800 gallons per minute and produced 45,000 pounds per day of high-quality copper cathodes. Full capacity of 4,000 gallons per minute and production of 100,000 pounds per day of cathodes are expected by the second half of 1980.

To conform with environmental standards, Inspiration in the past decade, constructed a new smelter and invested $60 million in control technology for air pollution. Despite these improvements, in November 1979, the Arizona Air Quality Control Bureau of the Arizona Department of Health Services cited the company for violating air quality standards. The company made some changes and proposed periodic shutdowns of the smelter and acid plant during air inversions until more permanent remedies could be installed. The company reported that approximately $59 million will be required for environmental expenditures from 1981 through 1983. Inspiration is also seeking to attain a zero discharge of contaminated water by constructing a $15 million water collection and treatment project to purify effluent stored at various locations at the mine.

An important development in ownership occurred on December 31, 1978, when Inspiration Holdings, Inc., was merged with and into Inspiration Consolidated Copper Co. Inspiration Holdings, a wholly owned subsidiary of Plateau Holdings, Inc., is indirectly owned equally by Hudson Bay Mining and Smelting Co., Ltd., of Toronto and by Minerals and Resources Corp., Ltd., of Bermuda (Minorco). Hudson Bay and Minorco are affiliated with Anglo American Corp. of South Africa. Also, the Anaconda Co., a subsidiary of Atlantic Richfield Co., holds a 20% interest in Inspiration; however, in October 1979, as part of the Federal Trade Commission antitrust settlement with Arco, it was ruled that Arco must sell its Inspiration stock within 1 year.

Kennecott Copper Corp., Ray Mines Division, has an open pit mine and concentrator at Ray and a smelter at Hayden in Pinal County. Copper is produced both from a sulfide and silicate ore. The sulfide ore is treated in the flotation concentrator; the silicate ore is treated by a hydrometallurgical process, and the resulting cathode copper is processed at the Chino Mines Division in New Mexico. Copper is also leached and precipitated from waste rock at the mine. Copper production from the Ray mine declined in 1978 but increased substantially in 1979. According to the company annual report, one reason for the decline was the average grade of ore, which dropped from 0.921% copper in 1977 to 0.856% copper in 1978, and an improvement to 0.876% copper in 1979. The limited smelter capacity restricted the larger scale production required to offset the drop in grade. A flood in December 1978 stalled full production into the first of the year. Molybdenum, silver, and gold contained in the ore were extracted as byproducts.

Various steps were taken to improve productivity in 1978 and 1979. At the mine, six new 250-ton waste haulage trucks began operating in 1978, and two additional 250-ton trucks were to be acquired in 1979. A large 60-R blast-hole drill was ordered in 1979 to replace a smaller 40-R machine. Average footage drilled was 314 feet per shift for the smaller machine and 520 feet per shift for the larger machine. More than 22,000 45-foot holes are planned to be drilled in a year with new unit. In 1978, a new dumping pocket and pan feeder were constructed at the primary sulfide crusher to provide a controlled flow of ore to the crusher at a rate of 2,000 tons per hour and to allow the use of the larger haulage trucks without damaging the crusher. During 1979, a regrind and filter facility was being constructed to improve the concentrate grade. A ball mill and string-drum filter plus piping, pumps, cyclone, and sumps were to be installed. The rougher copper concentrates recovered in the conventional flotation process would be diverted through the regrind mill and returned to flotation for upgrading. The string-drum filter was to replace one of the three conventional disk filters in the filter-plant building in the smelter complex. The new facility is to go into operation in late 1980.

A contract for designing a solvent-extraction plant was let in early 1978, the final design package received in August 1978, and construction commenced January 1979. The $15 million SX plant will upgrade the quality of the pregnant leach solutions of the 14,000-ton-per-day silicate-leach plant to produce an electrolytic-grade copper ready for direct shipment to fabricators. Impurities to be extracted by the process include iron, aluminum, and magnesium. Nominal recovery of the silicate plant is 30,000 short tons per year of cathode copper requiring reprocessing at the Hayden smelter and treatment at a refinery. Full operation, expected by March 1980, is to produce 105 short tons per day of high-quality wire-grade copper. Overall production will be increased by releasing smelter and refinery capacities for other materials.

In 1978, a new heat exchanger was installed in the sulfuric acid plant at the smelter, and in 1979 plans were announced for constructing a new drying tower at the acid plant.

Production from the Lakeshore mine remained suspended during 1978 and 1979. Located on the Papago Indian reservation lands 28 miles southwest of Casa Grande, Pinal County, the Lakeshore property was operated by the Hecla Mining Co. in an equal partnership with El Paso Natural Gas Co. Development of the mine began in 1970; the metallurgical plant construction was begun in 1972; and the integrated facility commenced operating January 1976. Total capital expenditures reached nearly $198 million.

Hecla faced difficult financial problems. Severely depressed copper prices, combined with some mining and metallurgical problems, contributed to operating losses in 1977; operations were suspended September 4, 1977. Fifteen hundred workers were laid off. After several fruitless attempts to obtain additional capital, Hecla and El Paso Natural Gas terminated their leases with the Papago Indian Tribe on October 31, 1978. When the property was returned to the Tribe, the companies granted the Papago's the option to purchase the removable plant and equipment at its appraised salvage value, about $10 million.

On April 1, 1979, Noranda Exploration Co., Inc., a wholly owned subsidiary of Noranda Mines, Ltd., of Toronto, Canada, leased the Lakeshore mine from the Papago Indian Tribe. According to the Noranda annual report for 1979, acquisition costs and expenses amounted to $16 million. During 1979, the company carried out a limited program of mine and plant rehabilitation and a comprehensive study of operational plans. The 6,000-ton-per-day oxide operation was scheduled to be brought into production by July 1980 at an estimated cost of $25 million. Development of the sulfide operation would not start before 1981, and then only if economic conditions improved. Plans are for the oxide ore to be mined by block caving, and treated by vat leaching. The solution is then to be taken to the existing electrowinning plant where a low-grade cathode will be produced.

Production at the San Manuel Division of Magma Copper Co., a wholly owned subsidiary of Newmont Mining Corp., averaged 61,005 tons per day with an average ore grade of 0.63% copper in 1979, compared with 54,752 tons per day and an average ore grade of 0.64% copper in 1978; and because of the strike, 47,575 tons per day in 1977. Normal capacity of the mine is 62,500 tons per day. According to the company, in addition to the copper produced at San Manuel, the ore yielded 2,955 tons of molybdenum sulfide, 525,406 ounces of silver, and 24,956 ounces of gold in 1978. Amount of ore produced in 1979 increased; however, recovery of copper declined, as did the amount of molybdenum sulfide, to 1,659 tons and the amount of gold to 24,613 ounces. Silver recovery increased to 532,267 ounces. A world record for hoisting from an underground mine was achieved when the 300-millionth ton of copper ore was hoisted from the San Manuel deep-level block cave mine on December 3, 1977. At this point, approximately one-third of the porphyry copper ore body had been mined. A description of the mining operation was published in 1978[6].

During 1978 and 1979, three reverberatory furnaces at the San Manuel smelter were modified to burn coal, fuel oil, or natural gas as availability and prices dictate. Electrostatic precipitators were installed to avoid an increase in particulate emission from the estimated 300,000 tons per year of coal required to fire the furnaces. Completed in 1979, the conversion was estimated to cost $25 million.

Preparations for and development of the deeper Kalamazoo ore body were continued throughout 1978 and 1979; initial production is planned for 1983.

The Magma Copper Co., Superior Division, underground mine about 64 miles east of Phoenix was operated at full capacity during 1978 except for a 3-week wildcat strike. According to the company, production at the Superior mine averaged 2,954 tons of ore per day containing 4.36% copper in 1978; production declined in 1979 to 2,734 tons per day, but contained 4.41% copper. An abnormally high seasonal flow of underground water into the Superior mine workings curtailed mine production early in 1979. In addition to the production of copper, the company reported recovery of 610,811 ounces of silver and 21,459 ounces of gold in 1978, and 628,967 ounces of silver and 22,815 ounces of gold in 1979.

The cumulative effects of environmental costs, rising energy costs, and inflation caused Magma's total production costs to rise in 1979. Cost of compliance with the environmental laws was estimated by the company to range from 10 to 15 cents per pound of copper produced. Adverse weather conditions and fugitive sulfur dioxide emissions in the smelter frequently curtailed smelting; consequently, production was reduced 10% so that air pollution control requirements could be met.

The Vekol Hills project of Newmont is located on the Papago Indian reservation near the village of Kohatk, Pinal County, on an easterly sloping pediment at the northeast edge of the Vekol Mountains, about 35 miles southwest of Casa Grande. After more than 4 years of negotiations, in December 1978, the Papago Indian tribal council approved an agreement for the possible development of an open pit copper mine by Vekol Copper Mining Co., a subsidiary of Newmont Mining Co. In 1978, the deposit was estimated to contain 105 million tons of 0.56% copper and 0.014% molybdenum in the sulfide ore, and 16 million tons of oxide ore.[7] The Papago Tribe will receive $3 million in royalty payments over the next 10 years and an additional percentage of operating income based on a formula that guarantees a minimum monthly payment of $54,116 if the mine goes into production.[8]

Phelps Dodge Corp. owns and operates three open pit mines in Arizona: the Morenci and Metcalf in Greenlee County and the New Cornelia or Ajo in Pima County. At each of the open pit mine, ores are converted to concentrates by a process of crushing, grinding, and flotation. Low-grade copper-bearing waste dumps are leached at Morenci and at the closed Bisbee operation in Cochise County, and tailings are leached at the Morenci and Metcalf open pits. Company concentrates and concentrates from other companies are treated at Douglas, Ajo, and Morenci smelters.

Recovery of copper in ores, concentrates, and precipitates at these operations totaled about 236,800 short tons in 1978 and about 242,300 short tons in 1979. The increase over the 192,200 short tons recovered in 1977 was attributed to the 6-week strike during the summer, as well as to depressed copper prices and the resulting reduced work schedules in 1977. In 1979, the increased production was obtained from the new leaching program on the southwest dumps at Morenci and from increased work schedules at the mines. Byproduct gold and silver were also recovered at these operations. In 1979, because of the increase in price of molybdenum, the molybdenum circuit at Morenci was reactivated, and the company sold approximately 425,000 pounds of moylbdenum in concentrate.

Phelps Dodge reported production costs at mines and smelters had increased significantly because of environmental control systems, inflation labor costs, fuel, and supplies; and an increase in depreciation expense. In 1979 average costs (excluding interest costs) for producing copper from mining through smelting, were approximately 153% of 1974 average costs.

In mid-1979, plans for expanding the Ajo pit were announced. The project, which requires relocating the mine office building, change room, most of the mechanical shops, and 135 privately owned homes, will permit the company to maintain the current rate of production. The company also reported that a hydrometallurgical process for recovering copper from sulfide concentrates was developd at Morenci and tested in 1978, and again in a 15-day pilot plant run in 1979.

In 1979, Phelps Dodge evaluated uranium recovery from its copper leaching operation at Bisbee. Copper is now leached from the low-grade dump material of the old underground mines and the now-closed Lavender pit. The company ran pilot tests for an ion-exchange uranium recovery unit that would be installed at the copper leaching plant. During December of 1979, in a trial operation at Bisbee, the company resumed underground mining at the old Campbell mine where low-grade ore was shipped. About 80 tons per day of the pyritic material containing gold, silver, and copper values was tested for improving copper recovery at the Hidalgo smelter in New Mexico. Barren pyritic material stockpiled on waste dumps in the area had been used previously.

At its sulfide copper deposit near Safford, Graham County, Phelps Dodge continued development work on a curtailed basis. Although $66.4 million has been invested in development work at the property since 1969, including $6.3 million in 1978 and $6.1 million in 1979, no decision has been made on when to bring the mine into production.

Development work at the Copper Basin project southwest of Prescott remained suspended in 1978 and 1979.

On October 14, 1977, Ranchers Exploration and Development Corp. suspended mining copper ore at the Bluebird mine, Gila County, because of low copper prices. During 1978, overburden was stripped and copper production continued from ore previously placed in leaching heaps. With an increase in the price of copper, mining was resumed in February 1979, and production gradually began to rise. The company reported the grade of ore was between 0.35% and 0.40% copper, compared with 0.5% on the remaining reserves.

In the first quarter of 1979, Rancher's began to rehabilitate the Old Reliable copper mine near Mammoth, Pinal County. Rock was first fractured in 1972 by coyotehole blasting; however, the mine was closed in 1975. Leaching was resumed August 1979, and by September, production was achieved. The deposit was leached with a mixture of sulfuric acid and water; leeching liquors were then drained from the area and pumped into a precipitation plant where cement copper was recovered. The company estimated 4 million pounds of recoverable copper remains in the breccia pipe deposit, sufficient to sustain the operation for 2 or 3 more years, depending on the price of copper. Ranchers manages the property and, in a joint operating agreement, controls about 83% of the working interest; E. I. duPont de Nemours & Co. controls the remaining 17%.

Occidental Minerals Corp., a subsidiary of Occidental Petroleum Corp., has spent over $11 million exploring and testing the Van Dyke Copper Co. and the Sho-Me Copper Co. copper deposit in Miami. Lying east of the Miami fault at a depth of 1,000 to 2,000 feet below the surface, the ore body is estimated to contain 100 million tons of oxidized copper mineralization with an average grade of 0.5% copper. The company plans to use an in situ leach method to recover the low-grade copper under the town site. The leach system has undergone testing for 4 years, and Occidental plans production testing in 1980.

The Oracle Ridge underground copper project is located on the north slope of the Santa Catalina Mountains north of Tucson. Continental Materials Corp. of Chicago and Union Miniere, S. A., of Brussels jointly expended about $8.6 million during 1978; $4.5 million for development, $3.4 million for plant and equipment, and about $700,000 for finance charges. Projects included 16 miles of roads, construction for office, warehouse, and maintenance facilities; mill design; conclusion of negotiations for power; and acquisition of mine and mill equipment.

Underground progress in 1978 totaled 11,357 feet of openings, bringing to 16,209 feet, or about 34% of the estimated amount required to complete primary access. However, high-cost ground-support problems emerged, and underground drilling showed a lack of mineral continuity in certain formations. On January 30, 1979, the partners suspended all mine development activities and major contracts and delayed delivery of machinery pending further study of all geologic data and reassessment of underground mining conditions. Initial exploration had indicated 10 million tons of copper ore at an estimated 2% mill feed, allowing for dilution. In 1979, the reassessment work done reduced the tonnage and increased the grade.

The equally owned joint venture of Hanna Mining Co. and Getty Oil Co. continued the copper exploration project operated by Casa Grande Copper Co., a Hanna Mining subsidiary. According to the 1979 Hanna Mining Co. annual report, delineation drilling of the copper deposit 7 miles west of Casa Grande was completed in 1979. The companies estimated that the deposit contains 350 million tons of material with an average grade of 1% copper at depths of 1,600 to 3,300 feet. Evaluation has continued on methods of mining and proccessing the oxide and sulfide ores; and in 1979, the Hanna Research Center in Minnesota reported major progress on a flow chart for the recovery of the copper. Industry sources report underground water may present a problem for a mining operation, but it is not believed to be insurmountable.

Table 4.—Arizona: Production and value of copper in Arizona and the United States

Year	Arizona copper production		U.S. copper production		Arizona
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Percent of U.S. copper production
1975	737,733	$1,044,162	1,282,184	$1,814,763	57.5
1976	929,339	1,425,994	1,456,561	2,234,975	63.8
1977	838,038	1,234,168	1,364,374	2,009,297	61.4
1978	891,405	1,306,866	1,357,586	1,990,323	65.7
1979	946,002	1,940,211	1,443,356	2,960,676	65.5

Table 5.—Arizona: Fifteen leading copper-producing mines in 1978, in order of output

Rank in 1978	Rank in 1977	Mine	County	Operator	Source of copper in 1978
1	3	Morenci	Greenlee	Phelps Dodge Corp	Copper ore and copper precipitates.
2	2	San Manuel	Pinal	Magma Copper Co	Copper ore and copper tailings.
3	4	Sierrita	Pima	Duval Sierrita Corp	Copper ore.
4	1	Twin Buttes	do	Anamax Mining Co	Do.
5	5	Ray	Pinal	Kennecott Copper Corp	Copper ore and copper precipitates.
6	6	Pinto Valley	Gila	Cities Service Co	Do.
7	8	Metcalf	Greenlee	Phelps Dodge Corp	Do.
8	11	Bagdad	Yavapai	Cyprus Bagdad Copper Co	Copper ore.
9	10	New Cornelia	do	Phelps Dodge Corp	Do.
10	12	Mission	Pima	ASARCO Incorporated	Do.
11	9	Superior	Pinal	Magma Copper Co	Do.
12	15	Inspiration	Gila	Inspiration Consolidated Copper Co.	Copper ore and copper precipitates.
13	14	Sacaton	Pinal	ASARCO Incorporated	Copper ore.
14	16	Silver Bell	Pima	do	Copper ore and copper precipitates.
15	17	Mineral Park	Mohave	Duval Corp	Do.

Table 6.—Arizona: Fifteen leading copper-producing mines in 1979, in order of output.

Rank in 1979	Rank in 1978	Mine	County	Operator	Source of copper in 1979
1	2	San Manuel	Pinal	Magma Copper Co	Copper ore and copper tailings.
2	4	Twin Buttes	Pima	Anamax Mining Co	Copper ore.
3	1	Morenci	Greenlee	Phelps Dodge Corp	Copper ore and copper precipitates.
4	3	Sierrita	Pima	Duval Sierrita Corp	Copper ore.
5	6	Pinto Valley	Gila	Cities Service Co	Copper ore and copper precipitates.
6	8	Bagdad	Yavapai	Cyprus Bagdad Copper Co	Copper ore.
7	5	Ray	Pinal	Kennecott Copper Corp	Copper ore and copper precipitates.
8	7	Metcalf	Greenlee	Phelps Dodge Corp	Do.
9	11	Superior	Pinal	Magma Copper Co	Copper ore.
10	9	New Cornelia	Yavapai	Phelps Dodge Corp	Do.
11	10	Mission	Pima	ASARCO Incorporated	Do.
12	12	Inspiration	Gila	Inspiration Consolidated Copper Co.	Copper ore and copper precipitates.
13	13	Sacaton	Pinal	ASARCO Incorporated	Copper ore.
14	14	Silver Bell	Pima	do	Copper ore and copper precipitates.
15		Esperanza	do	Duval Corp	Do.

Table 7.—Arizona: Material handled and copper produced at fifteen leading copper open pit and underground mines

Mine	Ore mined (thousand metric tons)		Waste material removed (excluding material placed in leach dumps) (thousand metric tons)		Material placed in leach dumps (thousand metric tons)		Total copper produced[1] (metric tons)	
	1978	1979	1978	1979	1978	1979	1978	1979
OPEN PIT								
Twin Buttes	6,165	12,620	20,263	35,347	4,318	1,739	91,205	101,930
Morenci	16,274	19,690	6,081	17,551	17,333	8,885	114,216	101,091
Ray	10,542	12,883	--	--	32,863	35,107	80,026	93,160
Sierrita	30,105	30,312	40,565	33,384	--	--	90,335	91,657
Pinto Valley	14,341	15,634	--	--	23,023	27,470	68,473	64,348
Bagdad	12,280	13,239	7,738	21,972	1,111	1,253	62,692	52,960
Metcalf	10,271	8,369	9,649	12,222	6,097	7,066	63,447	40,300
New Cornelia	7,698	9,230	7,466	9,481	2,954	--	38,899	39,615
Mission	7,056	4,370	16,038	3,329	--	--	36,054	25,422
Inspiration	5,125	5,498	7,207	9,677	6,546	8,782	34,493	19,842

See footnotes at end of table.

Table 7.—Arizona: Material handled and copper produced at fifteen leading copper open pit and underground mines —Continued

Mine	Ore mined (thousand metric tons)		Waste material removed (excluding material placed in leach dumps) (thousand metric tons)		Material placed in leach dumps (thousand metric tons)		Total copper produced[1] (metric tons)	
	1978	1979	1978	1979	1978	1979	1978	1979
OPEN PIT — Continued								
Sacaton	3,768	3,634	10,041	11,215	--	--	20,903	19,384
Silver Bell	3,238	3,368	3,322	3,458	1,361	1,476	19,292	16,631
Esperanza	(2)	4,445	(2)	--	(2)	--	(2)	11,373
Mineral Park	5,914	(3)	NA	--	NA	--	13,355	(3)
UNDERGROUND								
San Manuel	17,815	19,803	198	135	--	--	112,143	111,307
Superior (Magma)	890	383	58	82	--	--	36,974	37,334

NA Not available.
[1] Gross metal content.
[2] Not ranked in top 15 in 1978.
[3] Not ranked in top 15 in 1979.

Table 8.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Lode mines producing[1]	Material sold or treated (metric tons)	Gold		Silver	
			Troy ounces	Value	Troy ounces	Value
1977, total	35	155,105,103	90,167	$13,372,668	6,828,145	$31,546,031
1978:						
Gila	7	23,006,939	4,971	962,137	308,909	1,668,109
Greenlee	2	26,606,908	19,227	3,721,386	1,016,400	5,488,560
Pima	8	59,614,862	19,070	3,690,998	3,122,780	16,863,012
Pinal	7	34,676,433	48,467	9,380,787	1,495,166	8,073,896
Yavapai	1	12,279,656	1,221	236,325	422,224	2,280,010
Undistributed[2]	5	7,013,249	33	6,387	272,359	1,470,738
Total[3]	30	163,198,046	92,989	17,998,020	6,637,838	35,844,325
1979:						
Gila	8	28,725,272	(4)	(4)	357,848	3,968,534
Pima	8	68,382,901	(4)	(4)	3,771,193	41,822,530
Pinal	10	39,804,903	51,531	15,845,784	1,739,943	19,295,968
Yavapai	3	13,311,585	2,928	900,360	439,274	4,871,549
Undistributed[5]	13	35,261,215	47,381	14,569,661	1,170,684	12,982,886
Total	42	185,485,876	101,840	31,315,805	7,478,942	82,941,467

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1977, total	838,038	$1,234,167,897	288	$195,103	3,973	$3,013,097	$1,282,294,796
1978:							
Gila	114,268	167,525,929	--	--	--	--	170,156,175
Greenlee	171,435	251,337,362	--	--	--	--	260,547,308
Pima	285,985	419,275,109	308	229,039	W	W	W
Pinal	237,773	348,593,199	107	79,721	--	--	366,127,603
Yavapai	60,403	88,555,163	--	--	--	--	91,071,498
Undistributed[2]	21,540	31,578,779	1	369	W	W	W
Total[3]	891,404	1,306,865,541	416	309,129	W	W	W
1979:							
Gila	116,455	238,844,279	--	--	--	--	W
Pima	319,711	655,714,324	272	315,385	W	W	W
Pinal	254,794	522,571,966	48	56,277	W	W	W
Yavapai	57,344	117,611,107	1	802	--	--	123,383,818

See footnotes at end of table.

Table 8.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county —Continued

	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1979: —Continued							
Undistributed[5]	197,698	705,469,671	33	38,532	W	W	W
Total	946,002	1,940,211,347	354	410,996	W	W	W

W Withheld to avoid disclosing company proprietary data.

[1] Operations at miscellaneous cleanups not counted as mines.

[2] Includes Cochise, Graham and Mohave Counties combined to avoid disclosing company proprietary data.

[3] Data may not add to total shown because of independent rounding.

[4] Included in "Undistributed."

[5] Includes Cochise, Greenlee, Maricopa, Mohave, and Yuma Counties and gold from Gila and Pima Counties combined to avoid disclosing company proprietary data.

Table 9.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by class of ore or other source material

Source	Number of mines[1]	Material sold or treated (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
1978							
Lode ore:							
Silver	2	3,416	33	10,169	3	1	W
Copper-lead	27	161,661,026	92,508	6,611,781	824,481	323	W
Total[2]	29	161,664,441	92,541	6,621,950	824,484	324	W
Other lode material:							
Gold-silver tailings and copper tailings[3]	1	[4]1,443,927	448	15,888	9,876	93	--
Copper precipitates	12	89,678	--	--	57,046	--	--
Total	13	1,533,605	448	15,888	66,922	93	--
Grand total[2]	42	163,198,046	92,989	6,637,838	891,405	416	W
1979							
Lode ore:							
Gold and silver[3]	4	79,412	1,801	5,200	([5])	([5])	--
Copper-lead[3]	33	185,047,091	99,549	7,454,306	868,412	318	W
Total	37	185,126,503	101,350	7,459,506	868,412	318	W
Other lode material:							
Gold-silver tailings, silver tailings, and copper tailings[3]	3	[4]233,745	490	19,436	1,733	36	--
Copper precipitates	11	125,628	--	--	75,857	--	--
Total	14	359,373	490	19,436	77,590	36	--
Grand total	42	185,485,876	101,840	7,478,942	946,002	354	W

W Withheld to avoid disclosing company proprietary data.

[1] Detail will not add to total because some mines produce more than one class of material.

[2] Data may not add to total shown because of independent rounding.

[3] Combined to avoid disclosing company confidential data.

[4] Excludes newly generated tailings.

[5] Less than 1/2 unit.

Table 10.—Arizona: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
1978					
Lode:					
Cyanidation	--	--	--	--	--
Acid leaching (vat, tank, heap)[1]	--	--	89,454	--	--
Smelting of concentrates	92,459	6,610,226	729,299	309	W
Direct smelting of:					
Ore	82	11,724	5,732	15	W
Precipitates	--	--	57,046	--	--
Tailings[2]	448	15,888	9,876	93	--
Total[3]	530	27,612	72,653	107	W
Grand total[3]	92.989	6,637,838	891,405	416	W
1979					
Lode:					
Amalgamation	48	30	--	--	--
Cyanidation	1,746	1.809	--	--	--
Acid leaching[1]	--	--	82,769	--	--
Smelting of concentrates	99,089	7,435,053	779,449	276	W
Direct smelting of:					
Ore	467	22,614	6,192	42	W
Precipitates	--	--	75,858	--	--
Tailings	490	19,436	1,732	36	--
Total[3]	957	42,050	83,783	78	W
Grand total[3]	101,840	7,478,942	946,002	354	W

W Withheld to avoid disclosing company proprietary data.

[1] Includes copper recovered by electrowinning process.

[2] Includes miscellaneous copper cleanup.

[3] Data may not add to totals shown because of independent rounding.

In Santa Cruz County, Kerr-McGee Corp. ceased exploration for copper on Red Mountain near Patagonia. The copper mineralization was found at depths over 3,400 feet.

Copper was recovered as a byproduct or coproduct at 7 small operations in 1978, and at 14 small operations in 1979.

Gold.—Total value of gold production in the State increased about 74% in 1979, whereas the amount of gold produced increased only 10%. Ninety-seven percent of value of gold production was recovered as a byproduct at 13 large-scale copper operations; however, 12 small-scale (under 100,000 tons of material sold or treated) precious- and base-metal operations recovered gold in 1979. In the previous year, total value of gold production increased 35%, and the amount increased only 3% with 99.5% of the value of gold production was attributed to the rise in the average unit price of gold from $198.55 per troy ounce in 1978 to $307.50 per troy ounce in 1979. Gold production was obtained from San Manuel, Superior, New Cornelia, Morenci, Pinto Valley, Sacaton, Metcalf, Christmas, Bagdad, Twin Buttes, Ray, Sierrita, and Pima mines.

Lead.—In 1978, 4 small operators contributed 26% of the State's total value of lead production, compared with 13 small operators in 1979 producing 22% of the total value. Total value of the State's lead production increased about 7% in 1978 and nearly 33% in 1979, whereas the amount of lead production increase 44% from 1977 to 1978 and decreased 15% from 1978 to 1979. The average price of lead per pound in 1978 was $0.3370, and in 1979 $0.5264. Silver Bell, Sierrita, Mission, and Sacaton recovered byproduct lead in 1978 and 1979. Mineral Park also recovered byproduct lead in 1979.

Molybdenum.—The State was ranked second in shipment of molybdenum concentrates. In 1979, molybdenum was recovered entirely as a byproduct or coproduct at the following copper operations: Sierrita, Mineral Park, San Manuel, Bagdad, Twin Buttes, Esperanza, Eisenhower, Ray, Pinto Valley, Mission, Silver Bell, Pima, and Inspiration. The reopening of the Pima and Esperanza, and the startup of the Eisenhower mine contributed to an increase in the amount of molybdenum shipped; however, molybdenum recovery decreased at four mines. In 1979, Phelps Dodge announced the addition of a molybdenum plant at Ajo and reactivated its molybdenum circuit at

Morenci. Duval remained the largest molybdenum producer in the State.

Silver.—The increase in the average price of silver from $5.40 per troy ounce in 1978 to $11.09 per troy ounce in 1979 contributed substantially to the 131% increase in value of silver production while the amount increased 13%. The amount of silver production decreased in 1978, but the value of production rose 14%. The average price of silver in 1977 was $4.62 per troy ounce. Sixteen large-scale copper operations in 1978 and 18 in 1979 generated about 99% of the value of production of silver recovered as a byproduct in both years; however, the number of small operators recovering silver rose from 5 in 1978 to 16 in 1979. The small producers were precious- and base-metal operations. Leading Arizona producers of silver in 1979 included Twin Buttes, Sierrita, Morenci, Superior, San Manuel, Bagdad, Mission, Ray, Metcalf, New Cornelia, Pinto Valley, Mineral Park, Silver Bell, Sacaton, Pima, Christmas, Inspiration, and San Xavier.

Tungsten.—Small amounts of tungsten were shipped from the Big Banana mine near Sells, Pima County, in 1978 and 1979. Other production was reported from small mines near Nogales, Santa Cruz County, and Vicksburg, Yuma County.

Zinc.—In 1978 and 1979, the Mission and Sierrita mines recovered zinc as a byproduct from their copper mines. Mineral Park, Sacaton, and Silver Bell also obtained small amounts of byproduct zinc from their copper operations. Only one small operation recovered zinc in 1978 and 1979. The average price of zinc was $0.3100 per pound in 1978, compared with $0.3703 per pound in 1979.

NONMETALS

Asbestos.—Arizona is one of four States that produce asbestos. The Jaquays Mining Corp., operates a mine 33 miles northeast of Globe and a mill at Globe, Gila County. Other mills in the area are being closed and dismantled and tailings buried. Arizona Department of Health Services has required Jaquays to adhere to strict air pollution measures in the mill, and in handling ores, ore-storage piles, and tailings. Production of asbestos continued to decline through 1978 and 1979.

Cement.—Two companies continued to produce all the cement in the State in 1978 and 1979: the Phoenix Cement Co., a division of Amcord Inc., with offices in Phoenix and a quarry and plant 2 miles northwest of Clarkdale in Yavapai County; and Arizona Portland Cement Co., with a quarry 5 miles from the plant at Rillito in Pima County. Both portland and masonry cement continued to increase in amount and value during 1978 and 1979. Eleven Phoenix and Tucson concrete companies in 1979 were required to pay more than $5.1 million to settle price-fixing lawsuits brought by the Federal and State governments.

Clay.—Bentonite was mined by Filtrol Corp. at the Cheto No. 2 mine near Sanders, Apache County; by Superior Co., at the Verde mine near Clarkdale, Yavapai County; and by McCarrell and Gurley, Apache County. The Phoenix Brick Yard mined common clay shale at the Tolleson clay pit in Maricopa County and the Pantano pit, Pima County. Phoenix Cement Co., a division of Amcord Inc., mined common clay shale at the Lakebed mine in Yavapai County. Ball clay was obtained from the Weary Lode mine in Gila County by McKusick Mosaic Co.; and Magma Copper Co., Superior Division, mined fire clay at the Magma mine in Pinal County.

Total production of clay and shale increased in amount and value from 1977 to 1978 but declined in 1979.

Feldspar.—Hemphill Bros. shipped handcobbed feldspar from the Taylor mine in Mohave County during 1978 and 1979.

Fluorspar.—The Tonto Mining Co., the only producer in the State, shipped metallurgical-grade fluorspar from Gila County throughout 1978; however, production declined in 1979. In 1979, Triangle Mining Co. of Phoenix continued exploring a vein on McFadden Peak in the Tonto National Forest.

Gem Stones.—In 1978 and 1979, Arizona ranked first among the States for the production of gemstones. In 1979, turquoise was obtained by L. W. Hardy Co., Inc., in Mohave County and by Hardy Turquoise Co., Inc., and by the Pinto Valley Turquoise Operation in Gila County. Western States Stone Co. reported gemstones from the Seven Springs Onyx mine in Maricopa County.

Gypsum.—In 1978, National Gypsum Co. mined gypsum for plaster board at its Winkelman open pit near Feldman in Pinal County. Superior Companies mined the material for cement additives 4 miles southeast of Camp Verde near Clarkdale, Yavapai County, and also near Winkelman. Pinal Mammoth Gypsum Co. mined gypsum for agriculture 6 miles north of Mammoth, Pinal County. Production continued to climb in response to the requirements of the construction industry.

Lime.—Lime is used in the copper industry, and the resumption of full-scale production of copper as well as the use of lime in construction resulted in continued increase through 1978 and 1979. In 1978, lime was mined by Can-Am Corp., Paul Lime Division, at Douglas in Cochise County; Phelps Dodge Corp. near Morenci in Greenlee County; Amstar Corp. at Chandler in Maricopa County; Magma Copper Co. near San Manuel, Pinal County; and Flintkote Co., U.S. Lime Division, at Nelson, Yavapai County. In 1978, a $26 million expansion at the Nelson plant of U.S. Lime Division of Flintkote Co. increased the plant capacity to 1,800 short tons per day. The geology and operation at Nelson were described in 1978.[9]

Perlite.—In 1978, Filters International, Inc., mined perlite at an open pit 2 miles southwest of Superior in Pinal County, and Guzman Construction Co. mined perlite at an open pit mine 2 miles west of Superior. Only Filters International operated in 1979, and production declined. Perlite is used in filtering for pharmaceuticals, chemicals, sugar, beverages, and as an agricultural fertilizer carrier. Other uses include concrete aggregate, plaster board, and insulation board.

Pyrites.—Magma Copper Co., Superior Division, sold pyrite from its Magma mine in 1979.

Pumice and Volcanic Cinder.—Volcanic cinder was mined in Apache, Coconino, Graham, and Navajo Counties in 1978; and with the exception of Navajo County, also mined in the same counties in 1979. County, State, and Federal agencies mined the material principally for road construction in Apache, Coconino, and Navajo Counties. In Coconino County, in 1978 and 1979, Apple Masonry, Inc., processed volcanic cinder for concrete aggregate at the Apple mine near Flagstaff. Superlite Builders Supply, Inc., processed scoria for concrete aggregate at the Darling pit near Flagstaff; P. Zanzucchi obtained volcanic cinder for road construction near Flagstaff, and Flagstaff Cinder Sales Co. processed cinder for landscaping and other uses near Flagstaff for both years. Gila Valley Block Co. processed pumice and volcanic cinder for concrete aggregate and landscaping at the P-B-T pit near Safford in Graham County.

Salt.—Southwest Salt Co the only producer in the State, obtains the product as a brine from wells in Maricopa County. Salt is marketed for use as a water softener and for use in domestic and industrial tanneries. Production of salt increased 89% in amount and 119% in value in 1978, but dipped 3% in amount while increasing 11% in value in 1979.

Sand and Gravel.—Through 1978 and 1979, sand and gravel continued to be Arizona's third most valuable commodity, ranked after copper and molybdenum. Construction and industrial sand was supplied by 134 plants in the State, with the most being sold or used by Maricopa, Pima, Navajo, and Yuma Counties.

Major producers of construction sand includes Tanner Co. with deposits in Maricopa, Pima, Yuma, and Pinal Counties; Arizona Sand and Rock Co., with deposits in Maricopa County; Union Rock and Materials Corp. with deposits in Maricopa and Pima Counties; and New Pueblo Constructors, Inc., with deposits in Pima and Santa Cruz Counties.

Table 11.—Arizona: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	6,736	$17,543	$2.60	9,911	$29,143	$2.94	8,065	$25,985	$3.22
Plaster and gunite sands	NA	NA	NA	182	661	3.62	770	1,966	2.55
Concrete products	601	1,614	2.69	1,091	3,798	3.48	720	2,669	3.71
Asphaltic concrete	3,911	10,259	2.62	4,861	12,505	2.57	5,270	13,901	2.64
Roadbase and coverings	6,744	12,250	1.82	6,453	12,576	1.95	10,667	21,337	2.00
Fill	3,346	4,860	1.45	5,469	8,638	1.58	4,625	7,746	1.67
Snow and ice control	--	--	--	2	5	2.29	82	82	1.00
Railroad ballast	--	--	--	--	--	--	4	14	3.14
Other uses	894	2,539	2.84	203	570	2.81	318	1,017	3.20
Total[1] or average	22,231	49,064	2.21	28,172	67,896	2.41	30,520	74,716	2.45

NA Not available.

[1] Data may not add to totals shown because of independent rounding.

Table 12.—Arizona: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	7,531	$17,288	$2.30	10,079	$25,690	$2.55	9,640	$23,516	$2.44
Gravel	14,700	31,777	2.16	18,093	42,206	2.33	20,880	51,200	2.45
Total[1] or average	22,231	49,064	2.21	28,172	67,896	2.41	30,520	74,716	2.45
Industrial:									
Sand	82	881	10.73	W	W	W	W	W	W
Gravel	--	--	--	W	W	W	W	W	W
Total or average	82	881	10.73	143	1,200	8.39	W	W	W
Grand total[1] or average	22,313	49,946	2.24	28,314	69,096	2.44	W	W	W

W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Producers of industrial sand and gravel include Construction Fill Materials in Pima County, Arizona Silica Sand Co. in Apache County, Little Hill Mines, Inc. in Pinal County, and Maddox & Sons Ready Mix in Cochise County.

Stone.—Total stone production dropped during 1978, then increased during 1979. While dimension stone declined in amount in both years, crushed stone declined in amount in 1978 and increased in amount and value in 1979. Crushed stone accounted for about 99% of the total stone produced.

Major producers of crushed limestone for cement included Arizona Portland Cement Co., a division of California Portland Cement Co., in Pima County, and Phoenix Cement Co., a division of Amacord, Inc., in Yavapai County. U.S. Lime Division of Flintkote Co. mined limestone for lime in Yavapai County. Robert E. McKee, Inc., mined dolomite for railroad ballast in Mohave County. The R. E. McKee, Inc., ballast plant near Peach Springs, Mohave County, was described in 1979.[10] Kennecott Corp. in Gila and Pinal Counties, Phelps Dodge Corp. in Greenlee County, Magma Copper Co. and McFarland and Hullinger in Pinal County mined limestone and sandstone, which are used for flux at copper operations. Can-Am Corp.—Paul Lime Division mined limestone for flux and other uses in Cochise County. The U.S. Forest Service obtained limestone in Apache, Cochise, Coconino, and Navajo Counties for use in road construction. Other producers of crushed limestone in 1978 were E-Z Transmix, Inc., Maddoux & Sons Ready Mix, New Pueblo

Table 13.—Arizona: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Poultry grit and mineral food	1	25	1	26	W	W
Bituminous aggregate	81	236	28	43	4	6
Surface treatment aggregate	1	4	209	495	W	W
Other construction aggregate and roadstone	791	1,666	138	371	204	544
Dense-graded roadbase stone	7	16	49	W	--	--
Riprap and jetty stone	--	--	7	41	W	W
Manufactured fine aggregate	8	161	8	161	W	W
Terrazzo and exposed aggregate	--	--	W	W	31	289
Lime manufacture	807	3,310	818	3,673	1,265	5,935
Flux stone	825	3,031	695	2,522	702	2,867
Refractory stone	W	W	6	W	W	W
Roofing granules	W	W	W	W	14	199
Sulfur dioxide removal	W	W	15	119	33	242
Other uses[2]	2,838	7,919	3,330	10,220	3,516	11,319
Total[3]	5,359	16,367	5,306	17,669	5,769	21,401

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, sandstone, granite, marble, traprock (1978), and miscellaneous stone.

[2] Includes stone used for concrete aggregate (1978-79), macadam aggregate (1977), railroad ballast, filters, stone, cement manufacture, sugar refining, unspecified uses, and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Construction, and Superior Companies. Producers of crushed sandstone were Gilbert Construction Co., Nielsons Inc., Charlie Nichols, Little Hill Mines Co., O. B. Willis Construction Co. and Virgil Denning. Peter Kiewit Sons Co. mined traprock and Andrada Marble Co. and Catalina Marble Co. produced crushed marble in Pima County. Granite is obtained by the Madison Granite Co., Lawn Allen Supply Co., and Sanner Construction Co., in Maricopa County, and by A & A Materials, Inc., in Pinal County.

In 1978, producers of dimension stone included Catalina Marble Co., quarrying marble in Pima County; Apache Stone and Supplies, Inc., quarrying stone in Yavapai County and sandstone in Maricopa County; and Valley Stone Co., and Donald Norman, quarrying sandstone in Coconino County.

Vermiculite.—In 1978 and 1979, crude vermiculite shipped into the State was processed for building and agricultural uses by W. R. Grace & Co.

Zeolites.—In 1978 and 1979, production of the zeolite (chabazite) was estimated to be 2,500 short tons from deposits near Bowie. Ted. H. Eyde[11] reported The Anaconda Co. (which acquired claims held by Filtrol, Letcher and Associates), Norton Co., Union Carbide Corp. and W. R. Grace & Co. were producers in 1978; and Anaconda, Letcher and Associates, Union Carbide, and NRG, Inc., were producers in 1979. The material is shipped out of State for processing. A form of alteration product derived from volcanic ash or tuff—the bedded zeolite, chabazite—is being tested for uses as an absorbent and an ion-exchange media. In 1978, the processed chabazite was used to process pipeline-quality methane from sour gas produced from natural gas wells and from sanitary landfills, and for acid removal from reformer hydrogen streams. An investigation of the possible association of a zeolite mineral with mesothelioma (a rare form of lung cancer) in the villages of Karain and Tuskoy in central Turkey is under investigation by Government and industry.

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[1] State mineral specialist, Bureau of Mines, Denver, Colo.

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[8] Pay Dirt (Arizona Edition). Papagos and Newmont Agree on Vekol Mine Lease. No. 474, December 1978, p. 12.

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[10] Pit and Quarry. Arizona Plant Producing One Million Tons Per Year of Ballast. v. 72, No. 2, August 1979, pp. 104-105.

[11] Eyde, T. H. Bowie Zeolite an Arizona Industrial Mineral. Arizona Bureau of Geology and Mineral Technology Fieldnotes, v. 8, No. 4, December 1978, pp. 1-5.

——. Zeolites, Annual Review. Min. Eng., v. 29, No. 5, May 1978, p. 550, v. 31, No. 5, May 1980, p. 589.

Table 14.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos:			
Jaquays Mining Corp	1219 South 19th Ave. Phoenix, AZ 85009	Underground mine crushing, screening, air-separation plant.	Gila.
Cement:			
Arizona Portland Cement Co.,[1] Div. of California Portland Cement Co.	Box 338 Rillito, AZ 85246	Quarry and dry process, 3-rotary-kiln plant.	Pima.
Phoenix Cement Co.,[2] Div. of AMCORD, Inc.	3550 North Central Ave. Room 1501 Phoenix, AZ 85012	do	Yavapai.
Cinder:			
Flagstaff Cinder Sales, Inc	Box 2796 4400 Nyla Flagstaff, AZ 86001	Quarry	Coconino.
Superlite Builders Supply	Box 23163 Phoenix, AZ 85063	Open pit mine	Do.
Clays:			
Filtrol Corp	Box 155 Sanders, AZ 86512	do	Apache.
Phoenix Brick Yard	1814 South 7th Ave. Phoenix, AZ 85007	do	Maricopa.

See footnotes at end of table.

Table 14.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Copper:			
Anamax Mining Co.[3,5,6]	Box 127 Sahuarita, AZ 85629	Open pit and underground mines and plant.	Pima.
ASARCO Incorporated:			
Hayden Unit	Box 98 Hayden, AZ 85235	Smelter	Gila.
Mission Unit[3,5,7]	Box 111 Sahuarita, AZ 85629	Open pit mine and mill	Pima.
Sacaton[3,6,7]	Box V Casa Grande, AZ 85222	do	Pinal.
San Xavier Unit[5]	Box 111 Sahuarita, AZ 85629	Open pit mine	Pima.
Silver Bell Unit[3,5,7]	Silver Bell, AZ 85270	Open pit mine, mill, leach dumps, and precipitation plant.	Do.
Southwestern Mining Dept. Western Operations headquarters.	1150 North 7th Ave. Box 5795 Tucson, AZ 85703	Office and research	Do.
The Anaconda Co., Mineral Resources Group.	Box 27007 Tucson, AZ 85726	do	Do.
Cities Service Co., Miami Copper Co. Div.[3,5,6] (Pinto Valley Operation).	Box 100 Miami, AZ 85539	Open pit mine, mill, leach dumps, in-place leaching precipitation plants.	Gila.
Cyprus Mines Corp:			
Cyprus Bagdad Copper Co.[3,5,6]	Box 245 Bagdad, AZ 86321	Open pit mine and mill	Yavapai.
Cyprus Johnson Copper Co	Drawer R Benson, AZ 85602	Open pit mine, heap leach, solvent extraction-electrowinning plant.	Cochise.
Cyprus Pima Mining Co.[3,5,6,8]	Box 7187 Tucson, AZ 85725	Open pit mine and mill	Pima.
Duval Corp.:			
Esperanza and Sierrita properties.[3,5,6]	Box 125 Sahuarita, AZ 85629	Open pit mines, mills, leach dumps, precipitation plant.	Do.
Mineral Park property[5,7]	Box 1271 Kingman, AZ 86401	do	Mohave.
Inspiration Consolidated Copper Co.:[3,5]	Inspiration, AZ 85577	Open pit mine, mill, vat leaching plant, electrowinning plant, in place leaching, heap leaching, precipitation plant, rod plant rolling mill, custom smelter, electrolytic refinery.	Gila.
Christmas mine[5,6]	Inspiration, AZ 85577	Open pit mine and concentrator	Do.
Ox Hide mine	Inspiration, AZ 85577	Open pit mine	Do.
Kennecott Copper Corp. Ray Mines Div.[3,5,6]	Hayden, AZ 85235	Open pit mine, precipitation, vat leaching, electrowinning plants, smelter.	Do.
Magma Copper Co.:			
San Manuel Div.[1,3,5,6]	Box M San Manuel, AZ 85631	Underground mine, mill, smelter, refinery.	Pinal.
Superior Div.[5,6]	Box 37 Superior AZ 85273	Underground mine and mill	Do.
Phelps Dodge Corp.:			
Copper Queen Branch	Bisbee, AZ 85603	Underground mine, leach dumps, in place leaching, precipitation plant.	Cochise.
Douglas Reduction Works	Drawer E Douglas, AZ 85607	Smelter	Do.
Morenci and Metcalf Branch[5,6]	Morenci, AZ 85540	Open pit mines, mill, leach dumps, precipitation plant, smelter.	Greenlee.
New Cornelia Branch[5,6]	Drawer 9 Ajo, AZ 85321	Open pit mine, mill and smelter	Pima.
Safford Branch	Box 151 Safford, AZ 85546	Underground mine	Graham.
Cochise Mining Corp., San Juan Mine (Peacock Mine).[9]	Box 369 Safford AZ 85546	Open pit mine, dump leach, precipitation plant.	Graham.
Ranchers Exploration and Development Co., Bluebird Mine.	Box 880 Miami, AZ 85539	Open pit mine, dump leach, solvent extraction plant, electrowinning plant.	Gila.
Dolomite:			
Robert E. McKee Inc	Box 107 Peach Springs, AZ 86434	Quarry	Mohave.
Feldspar:			
Arizona Minerals Co	Box 4329 Kingman, AZ 86401	Open pit mine	Do.
Fluorite:			
Tonto Mining and Milling Co	Box 275 Tonto Basin, AZ 85553	Mine, mill, plant	Gila.

See footnotes at end of table.

Table 14.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Gold:			
Magma Copper Co.:			
San Manuel Div	Box M San Manuel, AZ 85631	*See Copper*	Pinal.
Superior Div	Box 37 Superior, AZ 85273	do	Do.
Phelps Dodge Corp.:			
Morenci and Metcalf Branch	Morenci, AZ 85540	*See Copper*	Greenlee.
New Cornelia Branch	Drawer 9 Ajo, AZ 85321	do	Pima.
Gypsum:			
National Gypsum Co	Star Route, Box 90 Winkelman, AZ 85292	Open pit mine and plant	Pinal.
Pinal-Mammoth Gypsum	2020 South 9th St. Coolidge, AZ 85228	Mine	Do.
Superior Companies[4]	2402 South 19th Ave. Phoenix, AZ 85009	Quarries and plant	Pinal and Yavapai.
Lime:			
Can-Am Corp., Paul Lime Div	Drawer T Douglas, AZ 85607	5 rotary-kiln plants	Cochise.
Kennecott Copper Corp., Ray Mines Div.	Hayden, AZ 85235	Kiln	Gila.
Phelps Dodge Corp., Morenci Branch.	Morenci, AZ 85540	Rotary kiln, fluidized-bed-kiln plant.	Greenlee.
Amstar Corp	11800 East Riggs Rd. Chandler, AZ 85224	Kiln	Maricopa.
The Flintkote Co., U.S. Lime Div	Box 197 Peach Springs, AZ 86434	Nelson quarries and plant	Yavapai.
Perlite:			
Filters International, Inc	Box Z Superior, AZ 85273	Open pit mine and plant	Pinal.
Guzman Construction.[9]	Box 7 Superior, AZ 85273	do	Do.
Salt:			
Southwest Salt Co	Box 1237 Litchfield Park, AZ 85340	Brine from wells	Maricopa.
Sand and gravel:			
Arizona Sand and Rock Co	Box 20067 1801 East University Phoenix, AZ 85036	Plants	Do.
Tanner Co	Box 20128 3640 South 19th Ave. Phoenix, AZ 85036	Open pits and plant	Maricopa and Pima.
Union Rock and Materials Corp	Box 8007 2800 South Central Ave. Phoenix, AZ 85066	Plant	Do.
Silica flux:			
Denning Mining Co	Ajo, AZ 85321	Open pit mine	Pima.
Gilbert Construction Co	Box 5288 Bisbee, AZ 85603	Quarry	Cochise.
Little Hill Mines, Inc	Box 332 Oracle, AZ 85603	Open pit mine	Pinal.
McFarland-Hullinger	Box 811 Tucson, AZ 85702	Plant and quarry	Gila.
O. Brice Willis	Box 1325 Clifton, AZ 85533	Open pit mine	Greenlee.
Stone:			
Andrada Marble Co	4901 East Drexel Tucson, AZ 85706	Quarry	Pima.
Western States Stone Co	2830 Grand Ave. Phoenix, AZ 85017	Quarries and plant	Coconino, Mohave, Yavapai, Yuma.
Vermiculite (exfoliated):			
W. R. Grace & Co	2925 Lyndon B. Johnson Freeway Dallas, TX 75234	Plants	Maricopa and Yuma.

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[1] Also lime.
[2] Also clays.
[3] Also molybdenum.
[4] Also clays and limestone
[5] Also silver.
[6] Also gold.
[7] Also lead and zinc.
[8] Idle 1978.
[9] Idle 1979.

The Mineral Industry of Arkansas

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Arkansas Geological Commission for collecting information on all nonfuel minerals.

By James H. Aase[1] and Wanda J. West[2]

The value of nonfuel mineral production in Arkansas for 1978 and 1979 was $265.1 million and $302.6 million, respectively. The increase in value of mineral production in 1979 over that of the previous year was attributed principally to the record output of bromine and the resumption of vanadium mining which was idle during most of 1978.

During the biennium 1978-79, over 4 out of every 5 dollars of the State's total nonfuel mineral value was contributed by 12 commodities of the nonmetallic sector. Leading the nonmetallic commodities in value was bromine, followed by, in descending order, cement, stone, sand and gravel, and others of lesser value. Bauxite was the leading metallic mineral mined in terms of value, followed by vanadium, the only other metallic mineral produced in the State.

Table 1.—Nonfuel mineral production in Arkansas[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Bauxite ___ thousand metric tons__	1,703	$24,851	1,446	$21,103	1,430	$20,555
Clays ______ thousand short tons__	988	5,407	1,137	5,119	1,044	7,686
Gem stones ____________________	NA	85	NA	150	NA	150
Lime ______ thousand short tons__	152	4,552	171	5,708	160	6,287
Sand and gravel __________do____	16,110	36,091	16,900	36,510	16,465	35,200
Stone:						
Crushed _____________do____	18,310	45,448	19,960	53,461	19,978	53,723
Dimension_____________do____	13	368	11	223	14	528
Combined value of abrasives, barite (1977-78), bromine, cement, gypsum, soapstone, tripoli, and vanadium. __	XX	169,582	XX	142,791	XX	178,493
Total__________________	XX	286,384	XX	265,065	XX	302,622

NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Arkansas, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Arkansas	--	W	Sand and gravel.
Ashley	$194	$297	Do.
Baxter	948	W	Stone, sand and gravel.
Benton	W	W	Do.
Boone	661	869	Sand and gravel, stone.
Bradley	286	20	Sand and gravel.
Calhoun	1,888	2,452	Do.
Carroll	W	W	Stone, sand and gravel.
Chicot	W	W	Sand and gravel.
Clark	W	W	Stone, sand and gravel, clays.
Clay	42	122	Sand and gravel.
Cleburne	513	W	Sand and gravel, stone.
Cleveland	--	W	Sand and gravel.
Columbia	W	W	Bromine.
Conway	W	541	Stone.
Craighead	1,282	2,216	Sand and gravel, clays.
Crawford	W	W	Sand and gravel, stone.
Crittenden	W	W	Clays.
Cross	384	448	Sand and gravel.
Dallas	11	10	Do.
Desha	W	W	Do.
Drew	324	145	Do.
Faulkner	W	1,343	Stone, sand and gravel.
Franklin	W	W	Sand and gravel, stone.
Fulton	W	W	Do.
Garland	W	W	Abrasives, stone, sand and gravel, vanadium.
Grant	415	323	Sand and gravel.
Greene	343	330	Do.
Hempstead	W	W	Sand and gravel, clays.
Hot Spring	W	W	Sand and gravel, stone, clays, abrasives.
Howard	19,325	W	Cement, gypsum, stone, sand and gravel.
Independence	W	8,362	Stone, lime, sand and gravel.
Izard	6,875	4,474	Sand and gravel, stone.
Jackson	92	W	Sand and gravel.
Jefferson	W	740	Do.
Johnson	W	W	Sand and gravel, clays.
LaFayette	862	611	Sand and gravel.
Lawrence	3,004	3,016	Stone, sand and gravel.
Lee	37	--	
Lincoln	544	410	Sand and gravel.
Little River	34,032	W	Cement, stone, sand and gravel, clays.
Logan	W	W	Stone, sand and gravel.
Lonoke	W	W	Stone, clays.
Madison	W	W	Sand and gravel.
Marion	671	764	Sand and gravel, stone.
Miller	2,733	W	Sand and gravel, clays, stone.
Mississippi	16	19	Sand and gravel.
Monroe	W	W	Do.
Montgomery	W	W	Barite, stone, sand and gravel.
Nevada	712	115	Sand and gravel.
Newton	W	W	Stone, sand and gravel.
Ouachita	1,852	2,330	Sand and gravel, clays.
Perry	349	W	Stone, sand and gravel.
Phillips	81	W	Sand and gravel.
Pike	W	W	Sand and gravel, gypsum, stone.
Poinsett	537	601	Sand and gravel.
Polk	212	519	Do.
Pope	W	W	Sand and gravel, stone.
Pulaski	W	W	Stone, clays, bauxite, sand and gravel.
Randolph	18	57	Sand and gravel.
St. Francis	1,046	1,063	Do.
Saline	26,911	W	Bauxite, lime, sand and gravel, stone, soapstone.
Scott	--	8	Sand and gravel.
Searcy	W	W	Stone, sand and gravel.
Sebastian	W	W	Stone, sand and gravel, clays.
Sevier	366	271	Sand and gravel.
Sharp	38	38	Do.
Stone	W	W	Stone, sand and gravel.
Union	W	W	Bromine.
Van Buren	W	W	Sand and gravel, stone.
Washington	W	W	Stone, sand and gravel.
White	W	W	Do.
Woodruff	W	W	Sand and gravel.
Yell	640	W	Sand and gravel, stone.
Undistributed[2]	178,137	232,553	
Total[3]	286,384	265,065	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Prairie County is not listed because no nonfuel mineral production was reported.

[2] Includes value of gem stones and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Arkansas business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	918.0	918.0	955.0	+4.0
Unemployment do	60.0	58.0	59.0	+1.7
Employment (nonagricultural):				
Mining[1] do	4.8	4.6	4.8	+4.3
Manufacturing do	209.3	217.5	216.9	-.3
Contract construction do	37.2	39.9	40.7	+2.0
Transportation and public utilities do	38.5	41.3	44.1	+6.8
Wholesale and retail trade do	150.1	158.7	162.9	+2.6
Finance, insurance, real estate do	29.3	30.4	31.0	+2.0
Services do	97.8	104.4	110.3	+5.7
Government do	128.6	135.9	139.2	+2.4
Total nonagricultural employment[1] do	695.6	732.7	749.9	+2.3
Personal income:				
Total millions	$11,653	$13,380	$14,792	+10.6
Per capita	$5,414	$6,121	$6,785	+10.8
Construction activity:				
Number of private and public residential units authorized	11,294	[2]9,877	8,446	-14.5
Value of nonresidential construction millions	$120.2	$120.4	$188.6	+56.6
Value of State road contract awards do	$170.0	$81.5	$192.8	+136.6
Shipments of portland and masonry cement to and within the State thousand short tons	1,006	1,027	954	-7.1
Nonfuel mineral production value:				
Total crude mineral value millions	$286.4	$265.1	$302.6	+14.1
Value per capita, resident population	$133	$121	$139	+14.9
Value per square mile	$5,393	$4,991	$5,699	+14.2

[p] Preliminary.

[1] Includes bituminous coal and oil and gas extraction.

[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Nationally, Arkansas ranked in the upper 50 percentile group of States in terms of value of nonfuel mineral output and led in the production of bauxite and bromine during the biennium. The State's production of nonfuel minerals during this period was obtained from more than 300 operations located in 73 of Arkansas' 75 counties. Columbia County, followed by Little River County were the State's leading counties in terms of value of nonfuel mineral output. Twenty-seven counties recorded production valued in excess of $1 million in each year of the biennium.

Trends and Developments.—Industrial development investments in the form of new facilities and equipment in Arkansas in 1979 exceeded that of 1978, with 61 companies announcing new plant investments totaling $223.1 million compared with $133.8 million for capital outlay for new facilities in 1978. Investments made in the expansion of existing industries were up in 1979, with 148 manufacturers reporting total capital expenditures exceeding $265.5 million. During 1978, 125 industries expanded for a total capital investment of $258.7 million in facilities and equipment, according to information compiled by the Arkansas Department of Economic Development and the State Chamber of Commerce.

Arkansas mining and mineral-related processing and manufacturing industries continued to expand their production base during 1978-79, with the opening of new mines and plants and expansions of others.

Arkansas Lime Co., a wholly owned subsidiary of Rangaire Corp., expanded the ground and dried limestone facilities at its plant near Batesville. In addition, the plant's quicklime production capacity was increased with the installation of a new kiln.

The Norton Co. completed construction of a new $11 million plant at Fort Smith and began manufacturing proppants (ceramic pellets) used in the hydraulic fracturing process in oil and gas wells, enhancing petroleum recovery. The proppants are an extremely tough sintered bauxite, spherical in shape and about the size of sand.

Milchem, Inc., a subsidiary of Baker International Corp., initiated activities towards opening a new barite mine and milling facility near Caddo Gap in Montgomery County. The new $30 million complex,

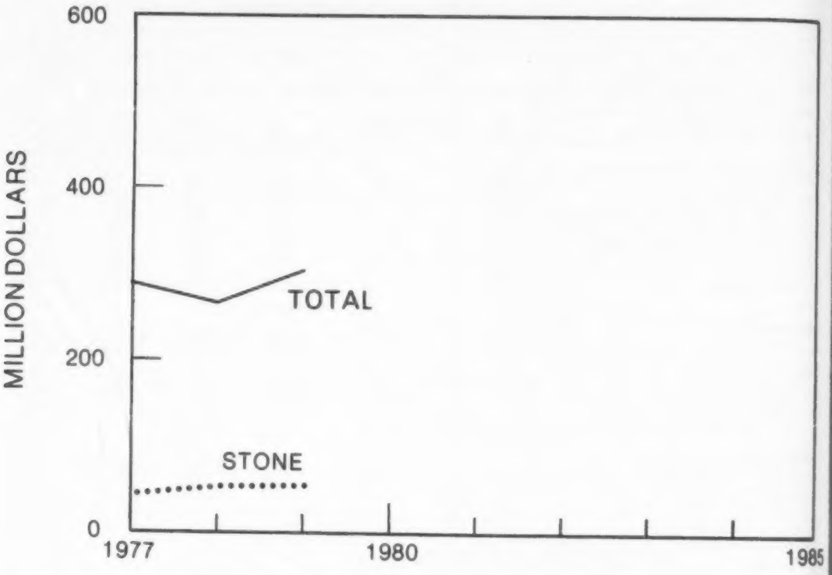

Figure 1.—Value of stone and total value of nonfuel mineral production in Arkansas.

scheduled to go onstream in January 1982, is expected to produce approximately 200,000 tons of ground barite annually.

Acme Brick Co., located at Malvern, completed a $1 million expansion project at its local plant that increased brick production capacity by 92%. The company also acquired the plant of Malvern Brick & Tile Co. and plans an expansion of that manufacturing facility.

In May 1978, the Reynolds Metals Co. broke ground and began construction of a continuous casting and cold rolling aluminum plant in Hot Spring County. The new $40 million facility is expected to be operational in 1980 when it will begin producing approximately 140 million pounds of aluminum foil feedstock per year. The plant will use molten aluminum from the company's aluminum reduction works nearby. In March 1979, Reynolds Metals announced plans to spend an additional $36 million to nearly triple the capacity of the plant under construction. The additional phase of plant expansion, scheduled to come onstream in 1982, is designed to meet projected growth for the mid-1980's in demand for household and food service foil products, packaging, and energy-saving insulation.

Minnesota Mining & Manufacturing Co. announced plans for a $25 million expansion project at its roofing granules production facilities near Little Rock. The principal rock type used in granule production at the facility is granite.

Great Lakes Carbon Corp. began construction of a $40 million plant near Ozark to produce graphite electrodes for use in electric arc furnaces. The plant will have an initial production capacity of 15,000 tons annually.

An effective measure of economic growth is the Gross State Product (GSP), which is an aggregation of the market value of all goods and services produced for final demand in the economy for any given year. According to statistics released by the Industrial Research and Extension Center, University of Arkansas, the mining and quarrying industries of the State accounted for 1.6% of Arkansas' GSP of $15.5 billion in 1978.

Employment.—According to statistics of the Employment Security Division, Arkansas Labor Department, the mining industry employed an average of 4,788 workers, with a payroll of $77.3 million in 1979, compared with a $69.7 million payroll for the 4,715 workers employed in 1978. In 1979, 1,392 workers in nonmetallic minerals (except fuels) production averaged $255 weekly; while workers in other mining averaged $380 on a weekly basis. Mining ranked third in the State in terms of average weekly wages paid to all classes of workers in 1978-79.

Legislation and Government Programs.—The Arkansas Legislature, which meets in regular session every other year, convened its 72d General Assembly in 1979. Legislation enacted relating to the mineral industry sector of the State, included measures that: Abolished the State Industrial Development Commission and created the State Department of Economic Development, which will conduct a program for attracting industries to the State and implement new programs for marketing the State's existing products and services both nationally and internationally; authorized the Arkansas Oil & Gas Commission to regulate the production of brine; and granted regulatory authority to the Department of Pollution Control and Ecology for the disposition of hazardous waste within the State in accordance with the "Arkansas Resource Reclamation Act of 1979."

The National Research Council Committee on Surface Mining and Reclamation of the National Academy of Sciences held public hearings in Arkansas during 1978 to study the degree to which requirements of the Surface Mining Control and Reclamation Act of 1977 (Public Law 95-87) would be applicable to the surface mining of minerals other than coal and how it would impact the affected industries. Bauxite mining operations and vanadium mining and milling operations were the focal points of the hearings and are most important to any future determination to be made concerning the applicability of the provisions of Public Law 95-87.

The U.S. Department of Agriculture, Forest Service, formally proposed 26 areas, comprising nearly 300,000 acres, as candidate areas for wilderness classification. Three of the proposed areas, known as Belle Star Cave, Dry Creek, and Richland Creek, were officially nominated to Congress as wilderness study areas and have been assessed by the Federal Bureau of Mines and the U.S. Geological Survey for their mineral potential. Substantial opposition to designating parts of other proposed wilderness areas was voiced by private landowners whose property would be included. Two State agencies, the Arkansas Industrial Development Commission and the State Pollution Control and Ecology Department, have indicated concern over the impact of wilderness designation on economic development in the State from the standpoint of the Clean Air Act of 1976, which impacts on industrial development adjacent to or near wilderness areas.

The Arkansas Geological Commission (AGC) was engaged in a variety of activities during the biennium, aimed at a better understanding of the State's geology and mineral and water resources. Included among the projects were:

–The completion of two geophysical surveys. A gravity survey was finished for a portion of the Mississippi Embayment north of Pine Bluff and west of the Mississippi River. An aeromagnetic survey covering 6,700 square miles of northeast Arkansas was also completed. Results of the two surveys, published as Bouguer Gravity and Magnetic maps, will provide needed tools for mineral exploration.

–Initiation of additional field work in the barite district due to increased interest in the commodity, together with completion of a report on the barite deposits at Dierks, Ark.

–The completion of an investigation and publication of a report on the antimony deposits of the State.

–A host of other activities in response to requests for services relating to the source, quality, and quantity of water supplied for various uses, in addition to providing information on environmental geology to the public with regard to flood risks, earthquake risks, and other concerns.

A mining institute for the State was established at Arkansas Tech University at Russellville by an executive order of the governor, following mid-1979 approval by the State Board of Higher Education. The institute, named Arkansas Mining and Mineral Resources Research Institute, is charged with the responsibility of planning and conducting investigations, demonstrations, and experiments of a basic or applied nature, in relation to mining and mineral resources and to provide for the education and training of miners, mine operators, and mineral engineers and scientists through such efforts.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Production of industrial minerals and rocks, together with their widespread use by the mineral-manufacturing industries in the State, significantly enhanced Arkansas' economy during 1978-79. The combined value of all nonmetal mineral commodities produced rose in each year of the biennium, advancing approximately 6% in 1978 and approximately another 9% in 1979.

Abrasives.—Novaculite, an exceedingly fine-grained cryptocrystalline quartzose rock of sedimentary origin, has been quarried and used as a natural abrasive material in whetstones since the first settlers came into the novaculite-bearing areas of the State, around 1818. The Zigzag Mountains, northeast and east of Hot Springs have, since around 1818, been a major source for novaculite used in the abrasives industry. During the biennium, novaculite produced for use in whetstone manufacturing was reported by three companies operating quarries in Garland County and one company operating in Hot Spring County.

Barite.—Arkansas recorded its 40th year of barite production in 1979. Since 1940, when systematic production of barite began in the Magnet Cove area in Hot Spring County, mining of the material has expanded to include operations in Howard and Montgomery Counties.

During 1978-79, the Baroid Div. of NL Industries, Inc., produced crude barite from an open pit mine in Montgomery County. The crude barite was ground and processed in the company-owned Magnet Cove plant in Hot Spring County. The processed material was used principally as a weighting agent in drilling muds.

At yearend 1979, Milchem, Inc., was awaiting required permits from appropriate State and Federal agencies prior to proceeding further in opening a new barite mine and flotation recovery plant in Montgomery County. Approximately $6 million is expected to be expended in mine development, including mining equipment for exploiting the deposit. The barite deposit was investigated by the Federal Bureau of Mines several years ago, and in the last several years, Milchem, Inc., has conducted extensive geological investigations and barite extraction research. The elongated barite deposit is to be developed by opencut mining and is expected to reach a depth of several hundred feet. Reportedly, approximately $1.25 million has been expended in acquiring property, exploration drilling, preparation of environmental impact statements, and related investigations. The operation is expected to employ about 140 people when onstream.

Bromine.—Arkansas accounted for the bulk of the Nation's bromine output and for more than half of the world's production during the biennium. The bromine was extracted from salt brines associated with oilfields in the south-central part of the State. The Smackover Formation of Jurassic Age, lying approximately 7,500 feet below the surface of the area of Columbia and Union Counties, was the principal geological horizon from which the brine was extracted. The bromine concentration in the brine reportedly was about 70 times greater than that found in seawater.

The elemental bromine and brominated compounds produced during the biennium came from six plants operated by five companies in Columbia and Union Counties. Dow Chemical Co. and Ethyl Corp. operated plants at Magnolia in Columbia County. Arkansas Chemicals, Inc., Velsicol Chemical Corp., and Great Lakes Chemical Corp. operated plants in Union County near El Dorado and Marysville. Bromine and brominated compounds dominated the industrial mineral sector in terms of value of production, accounting for approximately one-third of the value of all nonmetallic mineral commodities produced in the State during the period.

Velsicol Chemical Corp. proceeded with construction of a new $5 million brominated flame retardant plant at El Dorado. The new facility is expected to produce 10 million pounds of flame retardant annually and is scheduled to be onstream in 1980.

Cement.—Cement shipments by the State's two producers decreased slightly in quantity but increased moderately in value each year in the biennium.

Ideal Cement Co., a subsidiary of Ideal Basic Industries, Inc., and Arkansas Cement Corp., a subsidiary of Arkansas-Louisiana Gas Co., produced both portland cement and prepared masonry cement at plants in Saratoga, Howard County, and in Foreman, Little River County, respectively. These plants were established in 1929 and 1958, respectively, and utilize the wet process of cement manufacturing.

The State cement manufacturing industry consumed approximately 1.5 tons of mineral raw material mined in the State for each ton of cement produced during 1978-79. The in-State reserves of mineral raw material utilized by the cement industry are considered abundant and include the Annona Chalk and associated shale, pure iron-bearing sands of the Nacatoch Sand, iron oxide (included with the raw materials or derived from other sources), and gypsum from various sources in Arkansas.

Portland cement output, which accounted for more than nine-tenths of the total cement produced in the State during the biennium, consisted primarily of Types I and II, general use and moderate heat, with only minor amounts of Type III, high early strength, and other types manufactured. Ready-mix companies were the principal users of the portland cement produced, consuming more than half of the output. Over three-quarters of the portland cement shipped from the plants in the State was handled by truck in bulk form.

At mid-1978, the Arkansas Cement Corp. plant was struck by 170 employees, members of the United Cement, Lime & Gypsum Workers Union, over terms of a new 3-year contract offered by the company. During the 43-day strike, plant operations were maintained by management and temporary employees hired during the walkout.

Clays.—Arkansas' production of clays of various classifications was obtained from pits in 10 counties during the biennium. Crittenden, Hot Spring, and Lonoke Counties were the principal common clay producing counties, accounting for approximately three-fourths of the State's output of common clay. About half of the common clay produced was used in the manufacture of face brick.

Kaolin clay produced in Pulaski County by A. P. Green Refractories Co., a subsidiary of United States Gypsum Co., was used in the manufacture of refractory firebrick, blocks, shapes, and other products. In 1979, Stauffer Chemical Co. also produced kaolin clay in Pulaski County and used the output for manufacturing chemicals, pesticides, and related products.

Gem Stones.—The value of gem minerals collected in Arkansas in each year of the biennium was estimated at $150,000. The gem materials were recovered principally as a result of the recreational activities of individual mineral collectors and other hobbyists.

The Crater of Diamonds Mine near Murfreesboro, owned by the Arkansas Department of Parks & Tourism, continued to be a popular attraction for those wishing to hunt for diamonds. Since 1972, when the State bought the crater, more than 2,400 diamonds have been found. In 1978, the park was visited by approximately 120,000 persons who found 608 diamonds, the largest being a brown diamond weighing 8.61 carats. In 1979, 85,400 persons visited the park and found 411 diamonds, the largest weighing 5.1 carats. More than 65,000 diamonds reportedly have been found in the 78-acre volcanic crater since its discovery in 1906. The largest diamond found to date was the 40.23 carat "Uncle Sam" diamond recovered in 1924.

Gypsum.—Two companies accounted for all of the State's crude gypsum output during 1978-79. The production of crude gypsum decreased markedly in both quantity and attendant value in 1979 compared with that of the previous year.

Arkansas Gypsum Co., Inc., mined and ground crude gypsum from its operation near Murfreesboro in Pike County. Output was used extensively as an additive in cement manufacturing.

Weyerhauser Co. operated a mine and gypsum wallboard plant near Nashville in Howard County. In 1978, as a result of brisk sales of wallboard, the company put the plant on an around-the-clock operation. A computer control system was installed in some areas of the production line, and a series of minor plant changes were made to increase the rate and efficiency of production. The company supplies wallboard to a 15-State region that includes the southeast quarter of the United States.

Since the time that the first commercial production of gypsum was established in Arkansas in 1936, the gypsum beds in the geological formations of the DeQueen Limestone of Cretaceous Age have been an important source of the gypsum mined in the State. Although specific estimates of gypsum reserves have not been made, the gypsum belt begins in Howard County near Dierks and extends about 17 miles eastward into Pike County and contains many millions of tons of gypsum reserves.

Lime.—Arkansas Lime Co., a wholly owned subsidiary of Rangaire Corp., produced quicklime and hydrated lime at its plant near Batesville. The limestone used in the manufacturing process was mined at a company-owned quarry in Independence County. The output was used by the paper and pulp industries and for soil stabilization, water purification, and other uses. A plant expansion project, started in 1978 and completed by the end of 1979, increased the production capacity by approximately 50%.

Aluminum Company of America and Reynolds Metals Co. produced quicklime at plants in Saline County for their own use in the extraction of alumina from bauxite ore.

Consumption of quicklime and hydrated lime in Arkansas obtained from both in- and out-of-State sources, was 191,000 tons in 1979 compared with 173,000 tons the previous year.

Perlite.—Crude perlite, mined outside the State, was expanded by Strong-Lite Products Corp. at its Pine Bluff plant in Jefferson County in 1978-79. The expanded product was used for horticultural purposes, as low temperature insulation, and as an aggregate in concrete.

Sand and Gravel.—The quantity of sand and gravel produced in the State remained relatively constant during 1977 through 1979. Arkansas ranked 21st and 22d among the States in production of construction sand and gravel during 1978 and 1979, respectively. Approximately 200 companies and government agencies, operating from more than 200 sites in over four-fifths of Arkansas' 75 counties, accounted for the production of construction and industrial sand and gravel during the biennium.

Pope County led the State in sand and gravel output during 1978 and Calhoun County registered the greatest production in 1979. During each year, nearly one-third of Arkansas' sand and gravel output was provided by five counties.

Production from individual pit operations varied widely. In 1979, approximately 45% of the operations yielded less than 25,000 tons; 32% between 25,000 and 100,000 tons; 20% between 100,000 and 500,000 tons; and the remainder over 500,000 tons.

The major use of the construction sand and gravel produced during the biennium was for concrete aggregate which accounted for about half of the total.

Silica sand and industrial gravel production during 1978-79 was from operations of four firms in Crawford, Hempstead, Izard, and Ouachita Counties. The output was used extensively by the foundry and glass industries.

Most sand and gravel shipments were handled by truck with only minor amounts transported by rail.

Soapstone.—The Milwhite Co., Inc., produced soapstone (talc) in Saline County. The production increased both in quantity and attendant value in each of the biennium years. Output from the company mine was ground for roofing, insecticide carriers, rubber, and other miscellaneous uses.

Table 4.—Arkansas: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	6,526	$13,977	$2.14	7,757	$17,499	$2.26	7,020	$16,435	$2.34
Plaster and gunite sands	NA	NA	NA	W	W	W	223	463	2.08
Concrete products	651	1,462	2.24	418	964	2.30	157	407	2.59
Asphaltic concrete	2,287	5,068	2.22	1,998	4,477	2.24	2,469	5,393	2.18
Roadbase and coverings	4,627	7,614	1.65	5,126	9,072	1.77	4,836	8,145	1.68
Fill	1,174	1,331	1.13	857	1,023	1.19	1,171	1,505	1.28
Snow and ice control	NA	NA	NA	6	23	3.96	W	W	W
Railroad ballast	--	--	--	1	2	4.50	1	2	4.50
Other uses	301	445	1.48	167	311	1.86	87	244	2.80
Total[1] or average	15,567	29,897	1.92	16,330	33,370	2.04	15,964	32,594	2.04

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Data may not add to totals shown because of independent rounding.

Table 5.—Arkansas: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	5,917	$10,416	$1.76	6,859	$12,745	$1.86	6,737	$12,712	$1.89
Gravel	9,650	19,481	2.02	9,471	20,626	2.18	9,227	19,883	2.15
Total[1] or average	15,567	29,897	1.92	16,330	33,370	2.04	15,964	32,594	2.04
Industrial:									
Sand	W	W	W	W	W	W	501	2,605	5.20
Gravel	W	W	W	W	W	W	--	--	--
Total or average	543	6,194	11.41	566	3,135	5.54	501	2,605	5.20
Grand total[1] or average	16,110	36,091	2.24	16,900	36,510	2.16	16,465	35,200	2.14

W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Table 6.—Arkansas: Sand and gravel sold or used by producers, by county[1]

(Thousand short tons and thousand dollars)

County	1977			1978			1979		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Ashley	5	129	194	4	175	297	3	109	176
Baxter	--	--	--	2	W	W	3	185	341
Benton	4	58	106	3	33	79	2	W	W
Boone	5	159	247	3	207	543	1	22	88
Bradley	4	163	286	2	10	20	3	91	172
Calhoun	10	880	1,888	7	1,135	2,452	10	1,345	2,848
Clark	4	134	242	6	559	957	4	178	409
Clay	5	28	42	7	75	122	6	123	166
Cleburne	4	168	248	2	W	W	--	--	--
Craighead	11	670	1,242	9	951	2,167	7	547	1,149
Crawford	3	1,016	1,921	2	W	W	2	W	W
Crittenden	2	6	9	--	--	--	--	--	--
Cross	9	271	384	6	317	448	7	369	529
Dallas	1	8	11	1	6	10	1	6	10
Drew	5	182	324	4	95	145	3	81	123
Faulkner	2	235	409	1	252	414	2	479	W
Franklin	4	276	459	4	310	556	2	W	W
Fulton	6	112	210	3	81	165	4	100	197
Garland	5	194	257	5	224	391	5	409	698
Grant	6	190	415	6	187	323	5	216	278
Greene	7	220	343	8	181	330	5	120	260
Hempstead	4	54	106	3	54	124	3	54	124
Hot Springs	4	383	663	5	406	848	4	494	1,148
Howard	7	108	194	5	60	106	4	57	102
Independence	8	508	952	6	347	870	6	398	928
Izard	5	555	5,658	6	511	2,726	7	490	2,525
Jackson	3	45	92	2	W	W	2	W	W
Jefferson	2	W	W	3	360	740	2	W	W
Johnson	2	W	W	2	W	W	1	108	378
Lafayette	9	413	862	8	280	611	6	244	291
Lawrence	4	170	424	3	20	32	2	W	W
Lee	1	25	37	--	--	--	--	--	--
Lincoln	7	355	544	6	260	410	4	193	298
Madison	1	3	5	1	W	W	1	W	W
Marion	7	310	615	6	328	699	4	296	610
Miller	5	941	2,733	5	745	2,070	6	797	2,160
Mississippi	1	10	16	1	11	19	1	11	19
Montgomery	1	18	27	4	61	114	4	148	199
Nevada	4	492	712	4	66	115	4	214	366
Newton	2	15	22	2	W	W	--	--	--
Ouachita	8	710	1,852	8	882	2,330	8	999	2,519
Phillips	2	54	81	1	W	W	--	--	--
Pike	7	669	1,239	7	937	1,798	5	978	2,029
Poinsett	5	297	537	4	306	601	5	334	666
Polk	4	115	212	7	270	519	7	418	707

See footnotes at end of table.

Table 6.—Arkansas: Sand and gravel sold or used by producers, by county[1] —Continued

(Thousand short tons and thousand dollars)

County	1977			1978			1979		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Pope	4	452	784	4	1,157	2,194	5	587	1,177
Pulaski	3	1,071	1,859	2	W	W	2	W	W
Randolph	1	12	18	1	35	57	1	35	57
St. Francis	4	601	1,046	3	605	1,063	3	580	1,072
Saline	6	525	1,289	5	434	1,076	5	438	1,068
Scott	--	--	--	1	4	8	1	4	8
Searcy	4	43	65	1	25	38	1	25	38
Sevier	5	145	366	4	101	271	3	101	349
Sharp	2	25	38	1	25	38	1	25	38
Union	3	106	186	--	--	--	--	--	--
Van Buren	3	59	89	1	50	75	--	--	--
Washington	3	221	369	2	55	99	2	W	W
White	2	21	26	3	116	219	3	116	219
Yell	5	366	640	1	W	150	2	W	W
Undistributed[2]	16	1,160	2,495	18	3,587	7,074	15	3,951	8,674
Total[3]	266	16,110	36,091	231	16,900	36,510	205	16,465	35,200

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Columbia, Conway, Lonoke, and Prairie Counties are not listed because no production was reported.

[2] Includes Arkansas (1978), Carroll, Chicot, Cleveland (1978-79), Desha (1977-78), Little River, Logan, Monroe, Perry (1978), Sebastian, Stone, and Woodruff Counties, and data indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Stone.—Limestone, granite, sandstone, slate, and other miscellaneous stone were produced in the State during 1978-79. Stone ranked third in terms of value of all nonfuel minerals produced in Arkansas during each year.

Stone output increased in quantity and attendant value in both 1978 and 1979 over that of the previous year. In 1979, production was recorded from 66 quarries, operated by 41 firms, located at sites in 30 counties.

Pulaski County was the leading county in stone production during 1979, followed by Benton, Lawrence, Little River, and Independence Counties. These five counties, which produced more than 1 million tons each, collectively accounted for over three-fifths of the total State output. More than half of the State's total stone output during the biennium came from the operations of four firms.

Production from individual quarry operations throughout the State ranged widely in output. In 1979, approximately 29% of the quarries yielded less than 25,000 tons; 17% between 25,000 and 100,000 tons: 36% between 100,000 and 500,000 tons; 9% between 500,000 and 800,000 tons; and the remainder over 900,000 tons. More than 90% of all crushed stone shipments in 1979 were by truck.

Granite was crushed by six companies at seven quarries in Pulaski County in central Arkansas during 1979. The crushed rock was sold primarily for dense-graded roadbase material, concrete aggregate, other unspecified construction aggregate, railroad ballast, and roofing granules. The average selling price for all uses was $2.66 per ton.

Limestone, the leading rock type produced in Arkansas during 1979 in terms of both quantity and value, was produced at 27 quarries in 13 counties. Benton, Independence, Lawrence, and Little River Counties, each with production greater than 1 million tons, accounted for about 70% of the crushed limestone output. Except for Howard and Little River Counties, which are in the southwestern part of Arkansas, all of the producing counties were in the northern half of the State. Cement manufacture, dense-graded roadbase material, and concrete aggregate were the chief uses or products, each representing more than 1 million tons. The average selling price for all crushed limestone products was $2.55 per ton.

Crushed sandstone was produced from 27 quarries in 15 counties in various areas of the State. Crawford, Sebastian, Hot Spring, Perry, and White Counties, each with over 500,000 tons, led in tonnage produced, furnishing 61% of the crushed sandstone produced in the State in 1979. Dense-graded

Table 7.—Arkansas: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	568	1,618	450	1,322	400	1,267
Poultry grit and mineral food	W	W	55	444	W	W
Concrete aggregate	[2]1,096	[2]2,490	1,269	3,278	2,599	6,675
Bituminous aggregate	1,786	8,464	2,087	10,385	2,259	6,588
Dense-graded roadbase stone	4,076	8,623	4,914	10,934	4,965	12,085
Surface treatment aggregate	325	974	259	794	220	742
Other construction aggregate and roadstone	2,808	6,574	2,803	6,592	2,821	7,364
Riprap and jetty stone	1,530	3,242	1,198	2,642	475	1,550
Railroad ballast	988	2,223	1,457	3,509	1,570	4,074
Filter stone	44	116	53	146	101	252
Abrasives	W	W	W	W	7	65
Asphalt filler	W	W	W	W	100	752
Other fillers or extenders	W	W	W	W	21	140
Roofing granules	1,463	3,947	1,615	5,524	1,284	5,244
Other uses[3]	3,627	7,175	3,803	7,890	3,156	6,928
Total[4]	18,310	45,448	19,960	53,461	19,978	53,723

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes granite, limestone, sandstone, slate, and other miscellaneous stone.

[2] Includes manufactured fine aggregate (stone sand).

[3] Includes stone used for agricultural marl and soil conditioners, macadam aggregate (1978), manufactured fine aggregate (stone sand, 1978-79), cement manufacture, lime manufacture, flux stone, refractory stone (1977), fill, slate-flour, glass manufacture (1978-79), paper manufacture, other miscellaneous uses, and uses indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

roadbase material, unspecified aggregates, and bituminous aggregates were the principal uses of the output. The average selling price of all uses was $2.71 per ton.

Dimension sandstone from four quarries in Independence, Logan, and Sebastian Counties, totaling 14,000 tons, valued at $528,000, constituted the entire dimension stone output of Arkansas during 1979. Producers were Oran McBride Stone Co. at Batesville in Independence County, Logan County Building Stone Co., Inc., and Sunset Stone Co. at Paris in Logan County, and Hackett Stone near Hackett in Sebastian County. The output was sold as rough blocks, irregular-shaped stone, rubble, rough and dressed flagging, cut stone, sawed stone, and house stone veneer.

Crushed slate was produced at two quarries operated by Bird & Son, Inc., and The Milwhite Co., Inc., in Montgomery and Saline Counties, respectively, in central Arkansas. The material was used in the manufacture of roofing granules and slate-flour.

Sulfur.—Elemental sulfur was recovered at the natural gas processing plant of Phillips Petroleum Co. near McKamie in Lafayette County, and by Ethyl Corp. at its bromine extraction plant near Magnolia in Columbia County.

Tripoli.—Malvern Minerals Co. produced tripoli near Hot Springs in Garland County during the biennium. Output was used principally as a filler in various compounds and as an abrasive polish for metal parts.

Vermiculite.—Crude vermiculite, mined out of State, was exfoliated by W. R. Grace & Co. at its North Little Rock plant in Pulaski County and by Strong-Lite Products Corp. at its Pine Bluff plant in Jefferson County. The principal usage of the exfoliated vermiculite produced in 1979 was in paint texture, followed by block insulation and concrete aggregate, which collectively accounted for three-fourths of the output.

METALS

Bauxite.—Bauxite, the principal ore of aluminum, was first identified in Arkansas at a site in Pulaski County in 1877. The material was then being used as road surfacing material. Since the time of the first commercial production, recorded as 663 tons in 1898 for use in alum manufacture, bauxite production has increased in quantity and in importance to the growth of Arkansas' mineral economy.

During 1978-79, Arkansas led among the three States in the Nation that produced bauxite, accounting for more than four-fifths of the total national production. Three companies produced crude bauxite at four open pit mines in Pulaski and Saline Counties. Bauxite was processed to extract alumina at plants operated by Aluminum Company of America and Reynolds Metals Co. in Saline County.

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Table 8.—Arkansas: Mine production of bauxite and shipments from mines and processing plants to consumers in the United States

(Thousand metric tons and thousand dollars)

Year	Mine production			Shipments from mines and processing plants to consumers		
	Crude	Dry equivalent	Value[1]	As shipped	Dry equivalent	Value[1]
1975	1,892	1,568	22,956	1,913	1,625	25,486
1976	2,045	1,694	24,481	2,068	1,756	27,580
1977	2,048	1,703	24,851	1,964	1,684	26,532
1978	1,778	1,446	21,103	1,734	1,483	24,230
1979	1,685	1,430	20,555	1,695	1,442	24,600

[1] Computed from selling prices and values assigned by producers and from estimates of the Bureau of Mines.

Vanadium.—Union Carbide Corp. continued the mining and processing of vanadium-bearing ore at Wilson Springs, Garland County, for the 12th consecutive year in 1979. During 1978, output was down significantly with the cessation of operations for approximately 8 months due to a decline in demand for the company product, a ferrovanadium alloy used in steelmaking. With the resumption of operations in early 1979, output for the year improved markedly over that of 1978 but was still less than half of the 1977 production.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives (whetstones):			
Norton-Pike Div., Norton Co	Littleton, NH 03561	Mine	Garland.
Barite:			
NL Industries, Inc., Baroid Div.:	Box 1675 Houston, TX 77001		
McKnight Mine		do	Montgomery.
Magnet Cove Plant		Plant	Hot Spring.
Bauxite:			
Aluminum Company of America	1501 Alcoa Bldg. Pittsburgh, PA 15219	Mine and plant	Saline.
American Cyanamid Co	Berdan Ave. Wayne, NJ 07470	do	Do.
Reynolds Mining Corp	Box 398 Bauxite, AR 72011	Mines and plant	Pulaski and Saline.
Bromine:			
Arkansas Chemicals, Inc	Route 6, Box 98 El Dorado, AR 71730	Brine wells and plant.	Union.
The Dow Chemical Co	Midland, MI 48640	do	Columbia.
Ethyl Corp	451 Florida St. Baton Rouge, LA 70801	do	Do.
Great Lakes Chemical Corp	Box 2200 West Lafayette, IN 47906	do	Union.
Velsicol Chemical Corp	351 East Ohio St. Chicago, IL 60611	do	Do.
Cement:			
Arkansas Cement Corp., a subsidiary of Arkansas-Louisiana Gas Co.	Box 130 Foreman, AR 71836	Plant	Little River.
Ideal Cement Co., a subsidiary of Ideal Basic Industries, Inc.	Box 8789 Denver, CO 80202	do	Howard.
Clays:			
Acme Brick Co., Div. of Justin Industries, Inc.	Box 425 Fort Worth, TX 76101	Pits and plants	Hot Spring and Sebastian.
Arkansas Lightweight Aggregate Corp	El Dorado, AR 71730	do	Crittenden and Lonoke.
Eureka Brick & Tile Co	Box 379 Clarksville, AR 72830	Pit and plant	Johnson.
A. P. Green Refractories Co., a subsidiary of United States Gypsum Co.	1018 East Breckenridge St. Mexico, MO 65265	Pits and plant	Pulaski.
Stauffer Chemical Co	Box 9509 Industrial Station Little Rock, AR 72209	Pit and plant	Do.

See footnotes at end of table.

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[1] State mineral specialist, Bureau of Mines, Twin Cities, Minn.

[2] Program assistant, Bureau of Mines, Twin Cities, Minn.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Gypsum:			
Arkansas Gypsum Co., Inc	275 Shady Grove Rd. Hot Springs, AR 71901	Mine	Pike.
Weyerhaeuser Co	Route 4, Box 78 Nashville, AR 71852	Mine and plant	Howard.
Lime:			
Aluminum Co. of America	1501 Alcoa Bldg. Pittsburgh, PA 15219	Plant	Saline.
Arkansas Lime Co., a subsidiary of Rangaire Corp.	Box 2356 Batesville, AR 72501	Plant	Independence.
Reynolds Metals Co	6603 West Broad St. Richmond, VA 23226	do	Saline.
Perlite (expanded):			
Strong-Lite Products Corp	Pine Bluff, AR 71601	do	Jefferson.
Sand and gravel:			
Arkhola Sand & Gravel Co., a subsidiary of Ashland Oil, Inc.	Box 1627 Fort Smith, AR 72902	Pit and plant	Crawford.
Gifford-Hill & Co., Inc	Box 47127 Dallas, TX 75247	Pits and plants	Lafayette, Miller, Ouachita.
Jeffrey Sand Co	Box 998 Fort Smith, AR 72901	do	Faulkner, Pulaski, Sebastian.
St. Francis Material Co	Box 999 Forest City, AR 72335	do	Calhoun, Craighead, Poinsett, St. Francis.
Silica Products Co	Box 248 Guion, AR 72540	Mine and plant	Izard.
Stone:			
Granite:			
Freshour Construction Co., Inc.[1]	Box 77 Sweet Home, AR 72164	Quarry	Pulaski.
McGeorge Contracting Co., Inc	Box 7008 Pine Bluff, AR 71601	Quarries	Do.
Minnesota Mining & Manufacturing Co.	3M Center, 220 13W St. Paul, MN 55101	Quarry	Do.
Limestone:			
Arkansas Cement Corp., a subsidiary of Arkansas-Louisiana Gas Co.	Box 130 Foreman, AR 71836	do	Little River.
Arkansas Limestone Div., Rangaire Corp.	Box 2356 Batesville, AR 72501	Quarries	Independence and Izard.
Ashland Oil, Inc., McClinton-Anchor Co.	Box 1367 Fayetteville, AR 72701	do	Benton and Washington.
Ben M. Hogan Co., Inc	Box 2860 Little Rock, AR 72203	do	Izard and Lawrence.
Ideal Cement Co., a subsidiary of Ideal Basic Industries, Inc.	Box 8789 Denver, CO 80201	Quarry	Howard.
Midwest Lime Co	Box 608 Batesvilie, AR 72501	do	Independence.
Sandstone:			
Ashland Oil, Inc., Arkhola Sand & Gravel.	Box 1627 Fort Smith, AR 72901	Quarries	Crawford and Sebastian.
Ben M. Hogan Co., Inc	Box 2860 Little Rock, AR 72203	do	Garland, Pike, White.
M & M Rock Co., Inc	Box 1143 Conway, AR 72032	do	Faulkner and Perry.
Slate:			
Bird & Son, Inc	Drawer 151 Glenwood, AR 71943	Quarry	Montgomery.
Sulfur (recovered elemental):			
Ethyl Corp	Box 729 Magnolia, AR 71753	Sulfur recovered in bromine extraction.	Columbia.
Phillips Petroleum Co	724 Adams Bldg. Bartlesville, OK 74004	Sulfur recovered as a byproduct of petroleum refining.	Lafayette.
Talc and soapstone:			
The Milwhite Co., Inc	Box 15038 Houston, TX 77020	Mine and plant	Saline.
Tripoli:			
Malvern Minerals Co	Box 1246 Hot Springs, AR 71901	Mine	Garland.
Vanadium:			
Union Carbide Corp	Route 2, Box 563 Hot Springs, AR 71901	Mine and mill	Do.
Vermiculite (exfoliated):			
W. R. Grace & Co.	62 Whittemore Ave. Cambridge, MA 02140	Plant	Pulaski.
Strong-Lite Products Corp	Pine Bluff, AR 71601	do	Jefferson.

[1] Also produced sandstone in Lonoke County and limestone in Independence, Searcy, and Sharp Counties.

[illegible]

The Mineral Industry of California

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of Interior, and the California Division of Mines and Geology, Department of Conservation, for collecting information on all nonfuel minerals.

By D. W. Lockard,[1] J. F. Davis,[2] and P. K. Morton[3]

California's mineral production value in 1978 and 1979 totaled $1.5 billion, and $1.8 billion respectively. This increase can be attributed to general unit price increases and greater production of most nonmetallic minerals. Thirty-five mineral commodities, including nine metallic minerals, were produced in California in each of the past 2 years. Production of a number of commodities, including asbestos, boron compounds, carbon dioxide, clays, iron ore, mercury, perlite, rare earths, sodium carbonates, and talc, increased in 1979 when compared with that of 1978.

In 1978-79, California led the Nation in the production of asbestos, boron minerals, portland cement, diatomite, sand and gravel, rare earths, and tungsten. The State is also a major source of sodium sulfate and carbonate, pumice, perlite, and magnesium compounds.

Portland cement was the leading mineral commodity produced in terms of revenue; it was followed by sand and gravel, boron compounds, and crushed stone. The leading metallic commodity was iron ore, followed by tungsten. Altogether, nonmetallics accounted for nearly 92% of the State's mineral production value for 1978-79.

Employment.—California's mineral industry employment, excluding oil and gas extraction, was 10,000 at yearend 1979, a 6% increase over that recorded at the end of 1978. Extraction of nonmetallic and industrial minerals accounted for an estimated 77% of mineral industry employment.

Legislation and Government Programs.—Three Federal land use planning programs developed over the past 2 years may impact the State's mineral industry: RARE II, the Bureau of Land Management's (BLM) Wilderness Study, and the California Desert Conservation Area (CDCA) program. The U.S. Forest Service (USFS), through the RARE II process, identified 899,231 acres in California that may be desirable for wilderness classification, while also classifying 2,629,878 acres that needed further planning and evaluation. BLM had, by the end of 1979, classified 1,134,000 acres as Wilderness Study Areas (WSA) and was evaluating additional acreage for possible inclusion as a WSA. The most controversial land management plan was the CDCA. This 12.5-million-acre area was established in the Federal Land Planning and Management Act of 1976; BLM is to supply Congress with a management plan by September 30, 1980. During May 1978, BLM held 17 public meetings statewide on procedures to be followed to develop the master plan. Mineral extraction activities are an important economic factor in the CDCA. The area produces approximately $600 million worth of minerals annually, including all of the Nation's boron minerals, 97% of its rare-earth metals, and 15% of its talc supply. The comprehensive management draft plan is to be issued in early 1980.

Table 1.—Nonfuel mineral production in California[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Asbestos short tons	76,247	$18,372	70,728	$19,281	76,332	$20,434
Boron minerals thousand short tons	1,469	236,163	1,554	279,927	1,590	310,211
Cement:						
Masonry do	W	W	W	W	W	W
Portland do	9,271	406,185	9,290	473,486	9,724	541,815
Clays do	2,655	12,179	2,479	15,106	2,531	18,621
Copper (recoverable content of ores, etc.) metric tons	200	295	W	W	W	W
Diatomite thousand short tons	397	43,405	379	48,998	422	60,989
Gem stones	NA	230	NA	240	NA	240
Gold (recoverable content of ores, etc.) troy ounces	5,704	846	7,480	1,448	3,195	982
Gypsum thousand short tons	1,629	8,500	1,578	9,017	1,624	10,354
Lead (recoverable content of ores, etc.) metric tons	3	2	W	W	2	2
Lime thousand short tons	598	24,074	522	21,691	564	25,545
Mercury 76-pound flasks	W	W	--	--	151	43
Pumice thousand short tons	636	3,838	831	3,458	800	3,973
Sand and gravel do	109,135	250,951	115,100	281,400	129,348	347,385
Silver (recoverable content of ores, etc.) thousand troy ounces	58	267	58	313	64	712
Stone:						
Crushed thousand short tons	34,011	80,146	37,856	93,377	39,742	106,227
Dimension do	26	996	24	921	41	2,258
Talc short tons	95,602	2,373	105,865	3,795	175,752	6,960
Zinc (recoverable content of ores, etc.) metric tons	2	1	W	W	W	W
Combined value of calcium chloride, carbon dioxide, feldspar, iron ore, lithium compounds (1977-78), magnesium compounds, molybdenum, peat, perlite, phosphate rock (1977), potassium salts, rare-earth concentrates, salt, sodium carbonates, sodium sulfates, tungsten, and values indicated by symbol W	XX	241,064	XX	259,232	XX	312,924
Total	XX	1,329,887	XX	1,511,690	XX	1,769,675

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

In May 1979, the Department of the Interior issued an emergency land withdrawal totaling 69,305 acres in Ventura County. This action was taken to prevent area degradation by proposed uranium mineral exploration and to protect the Cositas Reservoir watershed for the cities of Ojai and Ventura.

A number of wilderness mineral resource assessment studies were in progress by the U.S. Bureau of Mines in the State during 1978-79. These studies were in the Carson Iceberg area (200,000 acres), Hoover Wilderness Area (100,000 acres), John Muir Wilderness Area (503,000 acres), North Fork of the American River study area (45,000 acres), San Gorgonio Wilderness Area (357,000 acres), and the Yolla Bolly-Middle Eel Wilderness Area (113,000 acres). The report on the Snow Mountain Study area (37,000 acres) was released as an open file report. RARE II mineral studies were underway in an additional 16 areas totaling 361,000 acres. Mineral assessments on BLM lands included Baker-Cypress/Lava Rock (20,000 acres) and Chemise Mountain-Kings Range (30,000 acres).

Assembly Joint Resolution 91 (AJR-91) was passed by the California legislature in 1978. The resolution requested that Congress move immediately to solve the steel import problem, created because foreign firms were underpricing local steel producers. The import problem was threatening to create economic problems for the State's iron and steel industry.

According to a 1978 staff study by the South Coast Air Quality Management District (SCAQMD), industry in Los Angeles, Orange, Riverside, and San Bernardino Counties may be required to spend an additional $890 million by 1985 to meet stringent air quality standards. The costs would fall heavily on refineries and on the Kaiser Steel facilities at Fontana.

The California Division of Mines and Geology had numerous scientific and geologic studies underway during the past 2 years. Research studies through the Geologic Hazards Program continued, such as active fault evaluation, cooperative studies with the U.S. Geological Survey on earth-

Table 2.—Value of nonfuel mineral production in California, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Alameda	W	W	Sand and gravel, salt, stone, clays.
Alpine	$239	$161	Silver, gold, zinc, lead, copper.
Amador	W	W	Sand and gravel, stone, clays.
Butte	W	W	Sand and gravel, stone, silver, gold.
Calaveras	38,256	48,789	Cement, asbestos, stone, gold, sand and gravel, clays, silver, copper, lead, zinc.
Colusa	W	W	Sand and gravel.
Contra Costa	W	W	Stone, sand and gravel, lime, clays.
Del Norte	920	W	Sand and gravel, stone.
El Dorado	W	W	Stone, sand and gravel, talc, gold, silver.
Fresno	9,076	11,788	Sand and gravel, stone, asbestos, gold, clays, tungsten, silver.
Glenn	W	W	Sand and gravel, lime.
Humboldt	2,066	2,498	Sand and gravel, stone.
Imperial	W	W	Gypsum, sand and gravel, lime.
Inyo	46,430	44,504	Tungsten, boron minerals, talc, stone, molybdenum, copper, perlite, sand and gravel, silver, pumice, clays, gold, lead.
Kern	[r]287,530	341,783	Boron minerals, cement, sand and gravel, stone, clays, gypsum, tungsten, carbon dioxide, salt, pumice.
Lake	W	1,745	Pumice, sand and gravel, stone.
Lassen	606	605	Sand and gravel, pumice, stone.
Los Angeles	W	W	Sand and gravel, stone, clays, lime, tungsten.
Madera	W	4,292	Tungsten, sand and gravel, pumice, stone.
Marin	W	W	Stone, clays.
Mariposa	W	W	Sand and gravel, stone.
Mendocino	1,233	1,484	Do.
Merced	1,186	W	Sand and gravel, silver, gold.
Modoc	W	W	Peat, sand and gravel, pumice, stone.
Mono	1,624	2,242	Pumice, tungsten, stone, clays, sand and gravel, gold, silver, copper, lead.
Monterey	W	W	Magnesium compounds, lime, sand and gravel, stone.
Napa	W	W	Stone, salt, sand and gravel.
Nevada	W	W	Sand and gravel, clays, stone.
Orange	W	W	Sand and gravel, feldspar, clays, stone.
Placer	W	W	Sand and gravel, clays, stone.
Plumas	W	W	Sand and gravel, stone.
Riverside	W	W	Iron ore, cement, sand and gravel, stone, clays.
Sacramento	W	W	Sand and gravel, gold, stone, silver.
San Benito	W	W	Asbestos, stone, sand and gravel, clays.
San Bernardino	[r]315,197	350,439	Cement, boron minerals, rare-earth minerals, stone, sodium carbonate, potash, sodium sulfate, sand and gravel, lime, clays, calcium chloride, talc, salt, pumice, lithium minerals, feldspar, iron ore, gold, tungsten, silver.
San Diego	37,439	39,133	Sand and gravel, stone, salt, magnesium compounds, clays, gypsum.
San Joaquin	W	W	Sand and gravel, lime, peat, gold, silver.
San Luis Obispo	W	3,725	Sand and gravel, stone, clays.
San Mateo	W	W	Magnesum compounds, stone, salt, sand and gravel.
Santa Barbara	W	W	Diatomite, sand and gravel, lime, stone.
Santa Clara	W	W	Cement, stone, sand and gravel.
Santa Cruz	W	W	Cement, sand and gravel, stone, clays.
Shasta	17,954	23,229	Cement, sand and gravel, stone, clays, pumice.
Sierra	W	W	Gold, silver, stone.
Siskiyou	2,172	2,290	Sand and gravel, stone, pumice.
Solano	7,546	3,929	Stone.
Sonoma	W	W	Sand and gravel, stone.
Stanislaus	W	W	Sand and gravel, gold, clays, silver.
Sutter	W	W	Sand and gravel, clays.
Tehama	491	906	Sand and gravel, stone, pumice.
Trinity	W	W	Stone, sand and gravel, gold.
Tulare	W	W	Sand and gravel, stone.
Tuolumne	W	W	Lime, stone, gold.
Ventura	W	12,969	Sand and gravel, clays, stone.
Yolo	W	W	Sand and gravel, lime.
Yuba	W	W	Sand and gravel, stone, clays.
Undistributed	559,924	615,223	
Total[2]	1,329,887	1,511,690	

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] No nonfuel mineral production was reported for Kings and San Francisco Counties.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of California business activity

		1977	1978	1979p	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	10,139.0	10,646.0	10,968.0	+3.0
Unemployment	do	834.0	756.0	687.0	-9.1
Employment (nonagricultural):					
Mining[1]	do	35.6	37.1	39.3	+5.9
Manufacturing	do	1,728.3	1,875.2	2,000.6	+6.7
Contract construction	do	366.1	417.5	460.6	+10.3
Transportation and public utilities	do	476.5	506.4	531.6	+5.0
Wholesale and retail trade	do	1,982.4	2,126.0	2,219.9	+4.4
Finance, insurance, real estate	do	505.4	553.2	591.5	+6.9
Services	do	1,764.7	1,931.3	2,065.5	+6.9
Government	do	1,739.0	1,750.4	1,728.8	-1.2
Total nonagricultural employment[1]	do	8,598.0	9,197.1	9,637.8	+4.8
Personal income:					
Total	millions	$174,739	$198,779	$224,969	+13.2
Per capita		$7,984	$8,916	$9,913	+11.2
Construction activity:					
Number of private and public residential units authorized		270,971	[2]245,302	213,936	-12.8
Value of nonresidential construction	millions	$3,801.5	$4,947.8	$6,221.8	+25.7
Value of State road contract awards	do	$430.0	$410.0	$490.0	+19.5
Shipments of portland and masonry cement to and within the State	thousand short tons	8,537	8,764	9,561	+9.1
Nonfuel mineral production value:					
Total crude mineral value	millions	$1,329.9	$1,511.7	$1,769.7	+17.1
Value per capita, resident population		$61	$68	$78	+14.7
Value per square mile		$8,380	$9,526	$11,152	+17.1

pPreliminary.

[1] Includes oil and gas extraction.

[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

quake hazard reduction, and other earth motion research. In 1978, the Division began a new regional geologic map series (1:250,000); the Sacramento 1° x 2° quadrangle was completed in 1979. Numerous geological publications and maps were released concerning the State's mineral resources. Mineral commodity investigations on tungsten resources were recessed during 1979 because of insufficient personnel. A sand and gravel aggregate study on the San Francisco Bay Area was published and released; this study was largely funded by a U.S. Bureau of Mines grant. A number of mine reclamation plans were reviewed by the Division as part of its responsibilities under the Surface Mining and Reclamation Act of 1975 (SMARA).

The State Mining and Geology Board acted on numerous mineral-related issues in 1979, most importantly those affecting the implementation of SMARA and APSSZA (Alquist-Priolo Special Studies Zones Act of 1972). The first formal lands classification (San Fernando Valley) was accepted and transmitted to affected land agencies as required by SMARA. The report identifies sand and gravel deposits needed to supply the projected 50-year demand of the region. The Board also conducted a mineral resource conservation forum to discuss land planning aspects on mineral recovery in the CDCA.

In February 1979, the Board signed a Memoranda of Understanding with the USFS and BLM for fulfilling respective regulatory responsibilities for surface mining and reclamation. The memoranda provides for mutual acceptance by local government and Federal agencies of each other's reclamation plans, mining operation plans, and environmental documents when they meet the individual agency's regulatory requirements.

Thirty new or revised Special Studies Zone maps, pursuant to Section 2622 of APSSZA, were released by the Board in 1979. These maps, which identify active fault zones and are subject to the requirements of APSSZA, were reviewed in public hearings before release.

The University of California at Berkeley was selected as one of the 31 Mineral Institutes authorized under Title III of Public Law 95-87 (Surface Mining and Reclamation Act of 1977). The University received two grants in 1978, one for $110,000 to establish the Institute and one for $160,000 to fund scholarships and fellowships.

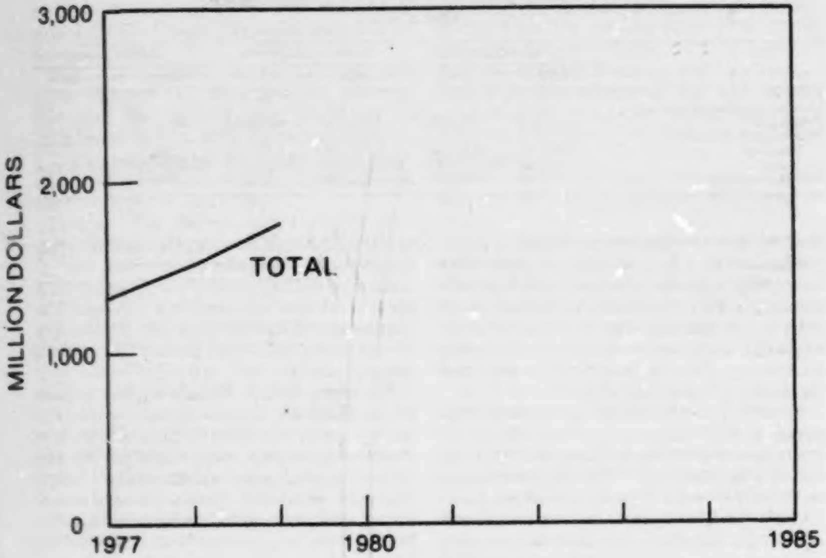

Figure 1.—Total value of nonfuel mineral production in California.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Asbestos.—Asbestos was produced by three companies in three counties in 1978-79. Calaveras Asbestos Ltd.'s Copperopolis Mine in Calaveras County was the State's leading producer both years. The other two producers were in Fresno and San Benito Counties.

Boron Minerals.—California operators were the Nation's only domestic producers of boron; mines are located in Kern, San Bernardino, and Inyo Counties. U.S. Borax and Chemical Corp. continued to be the largest producer, followed by Kerr-McGee Chemical Corp. and American Borate Co. In terms of value, pentahydrate was the leading boron compound produced in 1979.

New developments were highlighted by American Borate Co.'s Billie Mine, Inyo County. The mine, which lies within the Death Valley National Monument, is being developed underground through a three-compartment shaft sunk outside the monument boundary. Mine production, at full capacity, should reach 300,000 tons per year. The ore, colemanite-ulexite, will be trucked 40 miles to Lathrop Wells, Nev., for processing.

In 1979, Duval Corp. and N-L Industries were exploring a new borate deposit near Hector, San Bernardino County.

Calcium Chloride.—Output and value of calcium chloride rose in 1978 when compared with that of 1977; however, 1979 output and value exceed both previous years. The State had two producers in 1978-79, both at Bristol Lake, San Bernardino County—Leslie Salt Co. and the National Chloride Co.

Cement.—California continued to be the Nation's dominant cement producer in 1979, producing nearly 16% of the U.S. total. Value of portland cement produced increased for the past 2 years, although 1979 production fell slightly below that of 1978.

California Portland Cement Co. expects to double the capacity of its Mojave plant in Kern County by yearend 1980 with a $100 million modernization and expansion program. The new facility, constructed adja-

Table 4.—California: Portland cement salient statistics

(Short tons)

	Northern California		Southern California		California total	
	1978	1979	1978	1979	1978	1979
Number of active plants	4	4	8	8	12	12
Production	2,853,516	2,941,268	6,460,715	6,920,513	9,314,231	9,861,781
Shipments from mills:						
Quantity	2,866,424	2,893,971	6,423,407	6,829,718	9,289,831	9,723,689
Value	$147,686,160	$161,338,023	$325,800,005	$320,477,273	$473,486,165	$541,815,296
Stocks at mills, Dec. 31	153,158	218,983	236,656	237,099	389,814	456,082

cent to the existing plant, should expand production by 1 million tons per year. This new plant includes one large 250-foot kiln utilizing a four-stage suspension preheater with a precalciner, thereby incorporating the latest advances in cement maufacturing technology. Ground breaking for the new plant was in the spring of 1979.

In 1978, Kaiser Cement & Gypsum Corp. began a $72 million modernization of its Permanente plant near San Jose. The largest of the company's five manufacturing units, it is also the largest cement producer in the west. The 2-year program should not affect the plant's 1.6-million-ton-per-year capacity; the modernization is designed solely to reduce fuel requirements and air emissions.

In August 1978, the Flintkote Co., Calaveras Cement Div., announced a plan for a $40 million remodeling of its Redding facility. The remodeling should double capacity to 600,000 tons annually and reduce fuel consumption and particulate emissions; construction is expected to require from 27 to 36 months.

Creole Corp., a subsidiary of Texas Industries, Inc., proposed a new cement plant in Imperial County. According to the environmental impact report, Creole expects to mine limestone from the Coyote Mountains and construct a plant at Plaster City. A production capacity of 1.1 million tons per year is anticipated; a mining and reclamation plan has been filed and is presently under review.

Clays.—Both output and value of clay increased in 1979 compared with that of 1978. Common clay was the State's primary clay product in 1979, followed by bentonite. Lightweight Process Co. was the State's leading producer, with in excess of $5 million worth of common clay from two quarries in Ventura County. Two firms, McKittrick Mud Co., and Southern Clay of California, produced most of the bentonite clays from operations in Kern County.

The Gladding McBean Co. operation at Alberhill was purchased in 1979 by Pacific Clay Products, Inc., which is presently spending $2.5 million on plant modification to more fully automate production.

Interpace Corp. sold its refractory clay plants and mining operations in Ione, Pittsburgh, and Victorville to the Pacific Tin Group, a major tin and feldspathic materials producer.

Diatomite.—Four diatomite producers in Santa Barbara County accounted for the State's output in 1978-79. Since 1977, production increased only slightly, but the value received rose substantially. Johns-Manville Products Corp., Lompoc operations, was the largest producer both years. Most of the production (70%) was used for filtration purposes.

Preliminary studies were completed in 1979 on Grefco, Inc.'s Lake Britton Mine, Shasta County. According to the company, this area may contain the largest commercial-grade freshwater deposit of diatomite in the world; projected mine life is in excess of 50 years.

Feldspar.—Production of feldspar rose in 1979 when compared with that of 1978; value decreased by 27% for the same period. The product is a feldspar-silica mixture and most output was used in glassmaking.

Output came from two operations, Owens-Illinois, Inc.'s Mission Viejo Mine (Orange County) and Calspar Corp.'s Ord Mountain Mine (San Bernardino County); Calspar announced plans to construct a 48,000-ton-per-year processing plant at San Bernardino.

Gypsum.—California ranked fourth in the Nation in crude gypsum production in 1979; the State was first in output of calcined and byproduct gypsum for the same year.

In March 1978, Kaiser Cement and Gypsum Corp. sold nearly all its active gypsum business to Domtar, Inc., Montreal, Quebec, Canada, for $42.5 million. Domtar purchased two gypsum wallboard plants in Long Beach and Antioch; it also purchased a paper manufacturing plant in San Leandro, two gypsum ore carriers, and an interest in a major gypsum mine in Mexico.

Lithium.—Lithium production in California, from Kerr-McGee's Trona plant, was terminated early in 1978. Output for that year was small when compared with that of previous years.

Peat.—Rodel, Inc., Modoc County, and Delta Humus Co., San Joaquin County, were the State's only peat producers in 1978-79. Output in 1979 decreased slightly, while value received increased 26% when compared with that of 1978. Consumption was primarily by nurseries.

Perlite.—The State's entire perlite production came from one mine, the Fish Springs Quarry, Inyo County, operated by American Perlite Co./Redco Inc. Output and value in 1979 rose slightly when compared with that of 1978. Although well behind the leading State, New Mexico, in 1979, California was the second leading producer of perlite. Expanded perlite was produced at nine plants in 1978-79. Five Los Angeles County plants accounted for nearly 66% of the total State output; American Perlite Co.'s North Hollywood plant was the State's leading producer both years.

Phosphate Rock.—No phosphate rock production was recorded in either 1978 or 1979. Part of the stockpiled rock at the Cuyama Mine, Santa Barbara County, was disposed of during 1979.

Potassium Salts.—The State's entire production of potassium salts came from Kerr-McGee Chemical Corp.'s plant in San Bernardino County. Recorded sales in 1979 rose by 3% and value increased by 18% when compared with that of 1978. Marketed products included potassium sulfate (51.8% K_2O equivalent) and standard and coarse muriate (61.1% K_2O equivalent).

Pumice and Volcanic Cinder .—Output of pumice and volcanic cinders in 1979 fell 4% when compared with that produced in 1978. During 1978, there were 23 producers from 116 operations, compared with 20 producers from 124 operations in 1979. There was recorded production from 12 counties both years; Lake, Siskiyou, and San Bernardino Counties accounted for the largest production. Consumption was greatest as a concrete admixture, followed by road construction.

Salt.—Salt output and value were slightly down in 1979 when compared with those of 1978.

Leslie Salt Co. became a wholly owned subsidiary of Cargill, Inc., Minneapolis, Minn., in 1979. Leslie has about 45,000 acres of multihued saltbeds in the southern reaches of San Francisco Bay; it has the capacity to produce more than 1 million tons per year.

Sand and Gravel.—California continued to be the leading State producer of construction sand and gravel during 1978-79. More than 45% of the total production was used as concrete aggregate. State output in 1979 was from 366 deposits; 28 deposits yielded in excess of 1 million tons each for the year. Conrock Co. was the largest producer in 1979; it operated 18 deposits in Los Angeles, San Diego, Orange, and San Bernardino Counties. Other large producers were Lone Star Industries, Kaiser Industrial Sand and Gravel, and Livingston-Graham Inc.; these four companies accounted for 29% of the State's construction sand and gravel output.

Producers in Los Angeles, Alameda, San Diego, Orange, and Riverside Counties accounted for 43% of the State's output.

Owens-Illinois, Inc., with deposits in Amador and Orange Counties, is the State's largest producer of industrial sand and gravel; output was nearly 53% of the State total.

Table 5.—California: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	57,633	$134,276	$2.33	52,148	$127,443	$2.44	57,639	$150,964	$2.62
Plaster and gunite sands	NA	NA	NA	3,266	8,846	2.71	3,360	9,724	2.89
Concrete products	3,256	8,211	2.52	2,010	5,054	2.51	2,439	6,388	2.62
Asphaltic concrete	16,967	38,909	2.29	17,755	40,850	2.30	23,129	64,976	2.81
Roadbase and coverings	20,283	39,766	1.96	25,532	53,961	2.11	28,625	70,510	2.46
Fill	7,724	10,103	1.31	7,309	11,252	1.54	9,399	16,490	1.75
Snow and ice control	NA	NA	NA	W	W	W	20	71	3.48
Railroad ballast	157	470	3.00	193	640	3.31	142	455	3.21
Other uses	1,195	4,656	3.90	4,616	11,918	2.58	2,472	6,629	2.68
Total[1] or average	107,314	236,392	2.20	112,800	260,000	2.30	127,225	326,109	2.56

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Data may not add to totals shown because of independent rounding.

Table 6.—California: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	48,463	$100,309	$2.07	48,390	$108,353	$2.24	52,602	$131,909	$2.51
Gravel	58,851	136,084	2.31	64,439	151,591	2.35	74,623	194,200	2.60
Total[1] or average	107,314	236,392	2.20	112,800	260,000	2.30	127,226	326,109	2.56
Industrial sand	1,820	14,558	8.00	2,262	21,380	9.45	2,122	21,276	10.03
Grand total[1] or average	109,135	250,951	2.30	115,100	281,400	2.44	129,348	347,385	2.69

[1] Data may not add to totals shown because of independent rounding.

Sodium Carbonate.—The 1979 output of sodium carbonate was nearly double that reported in 1978. Value received showed a corresponding increase.

Kerr-McGee Chemical Corp. started the first of three production lines at its new Argus facility, Searles Lake near Trona, in the first half of 1978. The second line started the latter part of the same year, and the third came onstream in 1979. The Argus plant, when fully operational, is expected to increase the company's capacity to produce soda ash from 295,000 to 1.3 million tons per year.

Stone.—Output of crushed stone in 1979 came from a reported 156 quarries and rose 4% over that reported in 1978. More than 30% of the total crushed stone produced was limestone for cement manufacture. Leading producers of limestone were the Kaiser Cement and Gypsum Corp. and Southwestern Portland Cement Co. Operations in San Bernardino, Santa Clara, Alameda, Contra Costa, and Kern Counties accounted for almost 60% of the State's 1979 output.

Production and value of dimension stone rose dramatically in 1979 when compared with that reported in 1978. Output came from 19 quarries in 12 counties. V & M

Table 7.—California: Production of crushed stone,[1] by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	29	159	W	W	24	110
Poultry grit and mineral food	133	899	138	915	136	1,126
Concrete aggregate	2,515	5,358	2,562	5,582	1,743	3,750
Bituminous aggregate	1,876	4,626	1,538	4,357	2,385	6,927
Macadam aggregate	358	1,032	821	2,852	410	1,615
Dense-graded roadbase stone	7,707	17,684	10,408	21,534	8,683	20,006
Surface treatment aggregate	257	680	400	1,103	360	843
Other construction aggregate and roadstone	3,598	6,690	3,837	7,227	6,286	12,467
Riprap and jetty stone	639	2,160	1,537	4,677	1,799	5,472
Railroad ballast	W	W	242	552	158	432
Filter stone	113	281	211	485	218	631
Manufactured fine aggregate (stone sand)	W	W	176	1,210	W	W
Terrazo and exposed aggregate	131	1,396	130	1,529	170	1,754
Cement manufacture	12,693	23,550	12,374	24,399	13,230	29,276
Lime manufacture	522	1,407	562	1,816	744	2,610
Flux stone	50	113	56	178	110	561
Other fillers or extenders	218	1,614	268	1,908	327	4,203
Bedding materials	W	W	W	W	32	W
Fill	523	1,014	374	660	332	579
Glass manufacture	395	3,021	448	4,388	413	3,925
Roofing granules	933	2,261	1,043	2,498	756	2,078
Sugar refining	W	W	--	--	325	2,180
Acid neutralization	2	33	--	--	--	--
Other uses[2]	1,318	6,227	732	5,518	899	5,682
Total[3]	34,011	80,146	37,856	93,377	39,742	106,227

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, marble, miscellaneous stone, sandstone, shell, and traprock.

[2] Includes stone used for agricultural marl and other soil conditioners (1977-78), dead-burned dolomite, ferrosilicon, asphalt filler, whiting or whiting substitute, drain fields (1979), slate-flour (1979), mine dusting (1977), and other miscellaneous uses, and use indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Quarry Co. was the State's leading producer of dimension stone from its two quarries in Plumas County. Granite produced by Cold Spring Granite Co. in Fresno County had the highest value per ton because its end use was monumental stone. No quarry in the State produced more than 25,000 tons of dimension stone in 1979.

Sulfur.—Byproduct sulfur was recovered at 15 petroleum refineries in 4 counties—4 in Contra Costa, 9 in Los Angeles, 1 in Santa Barbara, and 1 in Solano. Total 1979 production was 474,000 metric tons valued at $12.2 million. Corresponding values in 1978 were 440,000 metric tons valued at $10.2 million. California ranked third in the Nation in 1979 for recovered sulfur shipped.

Talc, Soapstone, and Pyrophyllite.—Talc output from mines in Inyo and San Bernardino Counties increased 15% in 1979 when compared with that of 1978. Major producers were Pfizer, Inc., and Cyprus Mines. Value received for the period was almost double that of the previous year.

Pyrophyllite was produced by one operator in 1979; no production was reported in 1978.

Vermiculite (Exfoliated).—Crude vermiculite was imported from Montana and South Carolina. Production and value received for processed vermiculite increased slightly in 1978, when compared with that of 1977; it rose again in 1979. W. R. Grace & Co. was the only producer; it had two plants, one in Newark (Alameda County) and the other at Santa Ana (Orange County). There was no recorded production for either year from La Habra Products Co.'s plant at Anaheim (Orange County). Consumption by end use in 1979 was for fireproofing, in horticulture, concrete aggregate, and plaster. In 1979, California ranked seventh in the Nation in exfoliated vermiculite output.

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Chrome.—California produced no chrome in either 1978 or 1979. In 1979, American Chromium Ltd. and HELGENA Mines, Ltd., continued exploration drilling in Siskiyou County. California Nickel Corp., a subsidiary of Ni-Cal Ltd. of Vancouver, British Columbia, Canada, resumed exploration in 1979 on its property near Gasquet Mountain in Del Norte County. The company announced it would start its 5,000-ton-per-day plant sometime in 1981.

Copper.—Production of copper increased in 1978 when compared with that of 1977; however, 1979 output fell to slightly above that of 1977. Value received rose in 1978, and again in 1979 when compared with that of 1977. Production for both years continued to be byproduct copper. The Pine Creek Mine in Inyo County was the State's largest producer both years, producing nearly 90% of California's output.

Gold.—Gold production in 1979 fell to half of that reported in 1978. The number of mines reporting decreased from 22 in 1978 to 10 in 1979. In 1979, two mines, the Blazing Star (Calaveras County) and the Oriental (Sierra County), accounted for most of the State's output.

Yuba Goldfields Inc. announced in late 1979 that it had entered into an agreement with Placer Service Corp., a subsidiary of St. Joe Minerals Corp.; Placer Service is to spend $30,000 a month investigating ways to modify Yuba's dredges to dig deeper.

Iron Ore and Concentrates.—Usable iron ore shipments, which include direct shipping ore, concentrates, and agglomerates, rose 13% in 1979 when compared with those of 1978; value received increased by nearly 28%. California Portland Cement Co. and Standard Slag Co. produced only direct shipping ore from operations in San Bernardino County. Kaiser's Eagle Mt. Mine was the State's largest producer; most of the processing plant's production was in the form of agglomerates.

Iron Oxide Pigments.—Pfizer, Inc., produced numerous iron oxide pigments (yellow, brown, red, and black) at its Emeryville plant in Alameda County. Production decreased 2% in 1979 from that recorded in 1978; value rose 6% for the same period. The raw materials needed for this operation are not extracted in California.

Iron and Steel.—Production of pig iron rose 24% in 1979 compared with that recorded for 1978; value increased 31% for the period. Ending stocks in 1979 were only one-half of those recorded in 1978.

Lead.—Output of lead remained constant in 1978-79. Small quantities were produced both years as a byproduct from gold-silver ores.

Mercury.—In 1979 nearly all new mercury production came from one operation in Lake County. No output was recorded for 1978.

Molybdenum.—Value of molybdenum output tripled in 1979 when compared with that of 1978; production decreased approximately 5%. Union Carbide's Pine Creek Mine, Inyo County, was the State's only producer both years. All molybdenum was recovered as a byproduct of tungsten ore

Table 8.—California: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing[1]		Material sold or treated[2] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1977, total	6	1	4,101	5,704	$845,960	57,891	$267,458
1978:							
Eldorado	1	--	339	211	40,839	22	118
Fresno	--	--	--	716	138,581	104	562
San Bernardino	2	--	171	57	11,032	14	76
Trinity	--	1	--	3	581	--	--
Tuolumne	1	--	3	4	774	--	--
Undistributed[3]	8	1	14,967	6,489	1,255,948	57,874	312,519
Total	12	2	15,480	7,480	1,447,755	58,014	313,275
1979:							
Tuolumne	1	--	5	5	1,538		
Undistributed[4]	5	2	10,356	3,190	980,926	64,185	711,812
Total	6	2	10,361	3,195	982,464	64,185	711,812

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1977, total	200	$294,549	3	$2,030	2	$1,344	$1,411,341
1978:							
Eldorado	--	--	--	--	--	--	40,957
Fresno	--	--	--	--	--	--	139,143
San Bernardino	--	--	--	--	--	--	11,108
Trinity	--	--	--	--	--	--	581
Tuolumne	--	--	--	--	--	--	774
Undistributed[3]	W	W	W	W	W	W	1,983,498
Total	W	W	W	W	W	W	2,176,061
1979:							
Tuolumne	--	--	--	--	--	--	1,538
Undistributed[4]	W	W	2	1,889	W	W	2,222,746
Total	W	W	2	1,889	W	W	2,224,284

W Withheld to avoid disclosing company proprietary data.

[1] Operations from which gold and silver are recovered as byproducts from sand and gravel operations, not counted as producing mines.

[2] Does not include gravel washed.

[3] Alpine, Butte, Calaveras, Inyo, Merced, Mono, Sacramento, San Joaquin, Sierra, and Stanislaus Counties combined to avoid disclosing company proprietary data.

[4] Alpine, Calaveras, Inyo, Kern, Mono, Sacramentao, Sierra and Siskiyou Counties combined to avoid disclosing company proprietary data.

processing. No sulfide concentrates were produced in 1979.

Rare-Earth Minerals.—Production in 1979 of rare-earth minerals expanded nearly 17% when compared with that of 1978; value rose almost 40% for the same period. Molycorp's Mountain Pass operation in San Bernardino County continued as the Nation's prominent producer of rare-earth oxides.

In August 1978, Molycorp signed a contract with Stearns-Rogers, Inc., for construction of new rare-earth separation facilities at Mountain Pass. The multimillion dollar expansion will include six solvent extraction circuits. Growing demand for samarium and gadolinium prompted the expansion; also, added circuits will be built for recovery of cerium, lanthanum, neodymium, and praseodymium.

Silver.—In 1979, silver output increased slightly while value received more than doubled that in 1978. The bulk of production was as a byproduct from tungsten and gold mines; the State's largest producer both years continued to be Union Carbide's Pine Creek Mine, Inyo County.

ASARCO Incorporated continued exploration and feasibility studies on its Calico silver property in San Bernardino County; at yearend 1979, no decision on mining plans had been made.

Tungsten.—California remained the Nation's top tungsten producing State in 1978-79, accounting for more than one-half of the United States' newly mined supply. Output and value in 1979 decreased when compared with those of 1978. The largest producer both years was Union Carbide's Pine Creek Mine in Inyo County; Teledyne Tungsten's

Strawberry Mine, Madera County, was a distant second. In 1979, a total of 18 mines recorded production.

Zinc.—Zinc output remained at low levels in 1978-79. The Blazing Star Mine in Calaveras County was the only producer in 1979.

Table 9.—California: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by class of ore or other source material

Source	Number of mines[1]	Material sold or treated[2] (short tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
1978							
Lode ore: Gold, gold-silver, tungsten[3]	12	[4]15,481	3,921	57,841	W	W	W
Placer	2	--	3,559	173	--	--	--
Total	14	15,481	7,480	58,014	W	W	W
1979							
Lode ore: Gold, gold-silver, tungsten[3]	6	[4]10,361	W	W	W	2	W
Placer	2	--	W	W	--	--	--
Total	8	10,361	3,195	64,185	W	2	W

W Withheld to avoid disclosing company proprietary data.

[1] Operations from which gold and silver are recovered as byproducts from sand and gravel operations and copper which is recovered as a byproduct from tungsten operations are not counted as producing mines.

[2] Does not include gravel washed.

[3] Combined to avoid disclosing company proprietary data.

[4] Excludes tungsten ore tonnage.

Table 10.—California: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
1978					
Lode:					
Amalgamation, cyanidation and direct smelting of ore[1]	1,545	4,630	W	W	--
Smelting of concentrates[2]	2,376	53,211	W	W	W
Total lode material	3,921	57,841	W	W	W
Placer	3,559	173	--	--	--
Grand total	7,480	58,014	W	W	W
1979					
Lode and placer:					
Amalgamation, cyanidation and direct smelting of ore[1]	[3]1,501	10,749	W	1	--
Smelting of concentrates[2]	1,694	53,436	W	1	W
Total	3,195	64,185	W	2	W

W Withheld to avoid disclosing company proprietary data.

[1] Combined to avoid disclosing company proprietary data.

[2] Includes byproduct recovery from tungsten ore.

[3] Includes placer production.

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[1] State mineral specialist, Bureau of Mines, Spokane, Wash.

[2] State Geologist and Director, California Division of Mines and Geology, Sacramento, Calif.

[3] Minerals Officer, California Division of Mines and Geology, Santa Ana, Calif.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos:			
Calaveras Asbestos Corp	Box 127 Copperopolis, CA 95228	Open pit mine	Calaveras.
Union Carbide Corp.[1]	Box K King City, CA 93930	do	San Benito.
Boron minerals and compounds:			
American Borate Corp	Box 610 Lathrop Wells, NV 89020	do	Inyo.
U.S. Borax and Chemical Corp	Box 75128 Stanford Station Los Angeles, CA 90005	do	Kern.
Calcium chloride:			
Leslie Salt Co.[2]	Box 364 Newark, CA 94560	Solar evaporators.	San Bernardino.
National Chloride Co	Box 604 Norwalk, CA 90605	do	Do.
Cement:			
Amcord, Inc.[3]	1500 Rubidoux Blvd. Riverside, CA 92509	Plants	Various.
California Portland Cement Co.[4]	800 Wilshire Blvd. Los Angeles, CA 90017	do	Do.
Flintkote Co.[6]	San Francisco, CA 94104	do	Do.
Kaiser Cement & Gypsum Corp.[3]	300 Lakeside Dr. Oakland, CA 94666	do	Do.
Southwestern Portland Cement Co.[4]	Box 937 Victorville, CA 92392	do	San Bernardino.
Clays:			
Homestake Mining Co	Port Costa, CA 94569	Pit	Contra Costa.
Interpace Corp	2901 Los Feliz Blvd. Los Angeles, CA 90039	Pits	Various.
Lightweight Processing Co	650 South Grand Ave. Los Angeles, CA 90017	Pit	Ventura.
Pacific Clay Products Co	9500 South Norwalk Blvd. Los Angeles, CA 90017	Pits	Various.
Copper:			
Sierra Minerals Corp.[7]	Box 978 Mammoth Lakes, CA 93546	Mine	Mono.
Diatomite:			
Grefco, Inc	3450 Wilshire Blvd. Los Angeles, CA 90010	Open-pit mine, mill.	Santa Barbara
Johns-Manville Corp	2500 Miguelita Rd. Lompoc, CA 93436	Open pit mine	Do.
Feldspar:			
Owens-Illinois, Inc	Box 248 San Juan Capistrano, CA 92675	Pit	Orange.
Gold:			
Dickey Exploration Co	Box K Alleghany, CA 95910	Mine	Sierra.
Troy Gold Industries, Ltd.[8]	Box 5 West Point, CA 95255	do	Calaveras.
Lead:			
Claude B. Lovestedt[9]	Box 1496 Carson City, NV 89701	do	Alpine.
Lime:			
Kerr-McGee Chemical Corp.[10]	Box 367 Trona, CA 93562	Plant	San Bernardino.
Peat:			
Rodel, Inc	Box 7075 Reno, NV 89502	Mine	Modoc.
Perlite (crude):			
American Perlite Co	Box 579 Big Pine, CA 93513	Open pit mine	Inyo.
Pumice:			
Cinder Products Co	Box 206 Clearlake Oaks, CA 95423	do	Lake.
Hitchcock Bros. Cinders, Inc	Point Lakeview Rd. Lowerlake, CA 95457	do	Do.
Lavic Stone Corp	17171 South Western Ave. Gardena, CA 90247	do	San Bernardino.
Packway Materials, Inc	Box 777 Hat Creek, CA 96040	do	Shasta.
Red Lava Products of California	Star Route Clearlake Oaks, CA 95423	do	Lake.
Sand and gravel:			
Conrock Co	Box 2950, Terminal Annex Los Angeles, CA 90051	Pits	Various.
Granite Construction Co	Box 428 Fresno, CA 93624	do	Do.
Livingston-Graham, Inc	13550 Live Oak Ave. Irwindale, CA 91706	do	Do.
Owl Rock Products Co	Box 47 Irwindale, CA 91707	do	Do.
Rhodes and Jamieson, Ltd	333 Kennedy St. Oakland, CA 94604	Pit	Alameda.
Teichert Aggregates	3500 American River Dr. Sacramento, CA 95825	Pits	Various.

See footnotes at end of table.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone:			
Kopper Co., Inc.[11]	Box 580 Pleasanton, CA 94566	Quarries	Various.
Lone Star Industries[11]	2800 Campus Dr. San Mateo, CA 94403	do	Do.
Quarry Products, Inc	961 Western Dr. Richmond, CA 94801	do	Do.
Talc:			
Continental Minerals Co	1700 East Desert Inn Rd. Las Vegas, NV 89109	Mine	Inyo.
Cyprus Industrial Minerals Co	555 South Flower St. Los Angeles, CA 90071	do	Do.
Pfizer, Inc	Box 558 Lucerne Valley, CA 92356	Open pit mine	Do.
Tungsten:			
Teledyne Tungsten	4709 North El Capitan Ave. Fresno, CA 93703	do	Madera.

[1] Also copper, molybdenum, silver, tungsten.
[2] Also salt.
[3] Also iron ore, lime, sand and gravel, stone.
[4] Also stone.
[5] Also clays, stone.
[6] Also clays, lime.
[7] Also lead.
[8] Also zinc.
[9] Also silver.
[10] Also boron, lithium, potash.
[11] Also sand and gravel.

The Mineral Industry of Colorado

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Division of Mines of the State of Colorado, for collecting information on all nonfuel minerals.

By Karl E. Starch[1]

The value of nonfuel mineral production in Colorado was $649 million in 1978 and $826 million in 1979. These figures indicate a yearly continuing trend of new highs in the State's mineral industry production. The totals, however, are misleading as to underlying mining conditions. Much of the increase in value resulted from two factors, a general rise in prices and an increase in production of a relatively few commodities, most notably molybdenum. Generally, production of nonmetallics increased during this biennium, whereas that of metals, with the notable exception of molybdenum, decreased. A number of the State's most important base and precious metal producing mines were closed or reduced operations during the period.

Colorado ranked 10th among all States in value of production of nonfuel minerals. Molybdenum continues to provide an increasing portion of this total; one-half to two-thirds of the total in recent years. Colorado, however, has a more diversified mineral resource than most other States: 24 nonfuel minerals are produced in the State, 10 metals and 14 nonmetallic minerals. In 1977, for the first time, the value of metals produced exceeded that of petroleum and natural gas. The value of metals produced was 70% of the total nonfuel mineral value produced in 1978 and 80% in 1979. Colorado was ranked first in the Nation's production of molybdenum, tin (a byproduct of molybdenum production), and vanadium (largely a byproduct or coproduct of uranium production); second in tungsten (also largely as a byproduct of molybdenum production) and carbon dioxide; third in silver and lead; fifth in gold; and sixth in zinc. Much of Colorado's copper, gold, lead, silver, and zinc occur together in some combination in complex base metal ores.

Most of Colorado's metal production is shipped from the State to national and international markets.

The number of people employed in the mining sector in Colorado, relatively stable for a number of years, has increased at a nearly 14% rate annually since 1974. This trend, continuing through 1978-79, marked 5 straight years in which the rate of employment increase was greater in mining than in any other employment sector. However, mining employment is only 2% of the total employment in the State, and much of the increase in employment in the past 2 years resulted from energy companies moving their headquarters to Denver, an activity representing an increase in office workers (in the mining sector) rather than in the actual number of miners. The closing of several major mines in 1978 actually reduced the number of working miners in some areas of the State. In 1979, about 10,400 people were employed in metal mining in Colorado.

The value of nonfuel minerals produced in Colorado was about $259 per capita in 1978 and $329 in 1979, compared with a national average of $90 per capita in 1978.

Table 1.—Nonfuel mineral production in Colorado[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2] thousand short tons	961	$4,712	548	$2,753	521	$2,717
Copper (recoverable content of ores, etc.) metric tons	1,720	2,533	1,191	1,747	362	742
Gem stones	NA	100	NA	75	NA	70
Gold (recoverable content of ores, etc.) troy ounces	72,668	10,777	32,094	6,212	13,850	4,259
Gypsum thousand short tons	211	1,121	235	882	275	1,727
Lead (recoverable content of ores, etc.) metric tons	20,860	14,118	15,151	11,257	7,554	8,767
Lime thousand short tons	180	5,413	W	W	W	W
Peat do	32	195	30	188	33	299
Sand and gravel do	[3]23,910	[3]50,527	26,493	58,596	25,680	[3]56,263
Silver (recoverable content of ores, etc.) thousand troy ounces	4,663	21,545	4,217	22,773	2,809	31,151
Stone:						
Crushed thousand short tons	5,597	14,169	6,229	15,683	6,835	19,435
Dimension do	5	181	5	178	3	163
Zinc (recoverable content of ores, etc.) metric tons	36,530	27,704	22,208	15,178	9,910	8,149
Combined value of beryllium (1978), carbon dioxide, cement, clays (bentonite), feldspar (1977-78), iron ore, molybdenum, perlite, pumice, pyrites, salt, sand and gravel (industrial, 1977 and 1979), tin, tungsten concentrate, vanadium, and values indicated by symbol W	XX	[r]384,445	XX	506,304	XX	692,356
Total	XX	[r]537,540	XX	641,826	XX	826,098

NA Not available. [r]Revised. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes bentonite; value included in "Combined value" figure.

[3] Excludes industrial sand and gravel; value included in "Combined value" figure.

Legislation and Government Programs.—Colorado's mineral severance tax became law on January 1, 1978. Five categories of minerals are taxed, including molybdenum and other metallic minerals. However, since the first $11 million of gross income is exempted from the tax, no other metallic mineral mines yet qualify to be taxed. AMAX Inc., the only molybdenum producer in the State, pays $0.15 per ton of molybdenum ore produced. In 1978, the tax brought in $16 million in revenue to the State; $3.6 million from molybdenum production. Receipts from the severance tax are distributed 40% to the State's general fund, 15% to the severance trust fund, and 45% to the local government tax fund. A proposal in the 1979 legislature to double the severance tax was rejected in committee. A State law enacted in 1979 allows companies developing new mineral operations to "prepay" severance taxes directly to affected local governmental agencies, including school districts, so that funds are available when most needed to meet the costs of increased population related to the new mining operation.

The Federal Mine Safety Act of 1977, effective March 1978, transferred responsibility for mine safety inspection from the State Division of Mines to the Mine Safety and Health Administration (MSHA) of the U.S. Department of Labor. The role of the State Division of Mines became one of training certification, education of miners, and to provide technical assistance to small mine owners. In 1979, State mine safety statutes were rewritten as the State sought a continuing role in mine safety inspection of small mines. The future role of the State Division of Mines is still uncertain. Smaller mine operators supported the Colorado Legislative Memorial asking Congress to let States regulate mining.

A Federal law enacted in 1978 provides for cleanup of abandoned radioactive uranium mill tailings in the West, with the Federal Government to pay 90% of the cleanup costs, and States to pay 10%. Colorado sites eligible for cleanup funds are Durango and Rifle (two sites each), Gunnison, Maybell, Naturita, and Slick Rock.

Among contracts awarded by the Bureau of Mines during the biennium was a $159,000 contract to develop low-cost methods for sealing the surface openings to abandoned mines in western Colorado.

The State received $11 million as its share of Federal mineral leasing, bonuses, royalties, and rentals for fiscal year 1979 which ran from October 1, 1978, through September 30, 1979. Under the Mineral

Table 2.—Value of nonfuel mineral production in Colorado, by county

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Adams	W	$6,616	Sand and gravel.
Alamosa	$229	W	Peat.
Arapahoe	3,550	3,747	Sand and gravel.
Archuleta	W	--	
Baca	3	--	
Boulder	28,993	31,054	Cement, sand and gravel, stone, gold, silver, clays, lead, zinc, peat, copper.
Chaffee	W	W	Stone, sand and gravel, peat, lead, silver.
Cheyenne	6	--	
Clear Creek	W	W	Molybdenum, sand and gravel, gold, lead, silver, copper.
Conejos	W	--	
Costilla	W	W	Pumice, sand and gravel.
Crowley	19	34	Sand and gravel, stone.
Custer	W	W	Perlite.
Delta	W	751	Sand and gravel.
Denver	81	73	Sand and gravel, stone.
Dolores	256	72	Stone.
Douglas	W	W	Clays, sand and gravel, stone.
Eagle	W	2,551	Silver, sand and gravel, copper, gold, pumice, lead, stone.
Elbert	331	262	Sand and gravel, clays.
El Paso	W	W	Sand and gravel, stone, clays.
Fremont	39,647	43,424	Cement, stone, sand and gravel, gypsum, clays, feldspar.
Garfield	672	W	Sand and gravel, stone.
Gilpin	W	W	Gold.
Grand	488	373	Sand and gravel.
Gunnison	W	W	Sand and gravel, stone, silver, lead.
Hinsdale	1	--	
Huerfano	101	96	Sand and gravel.
Jackson	28	26	Do.
Jefferson	W	W	Sand and gravel, stone, clays, gold, silver.
Kit Carson	W	157	Sand and gravel, stone.
Lake	230,171	273,075	Molybdenum, tungsten, silver, zinc, lead, gold, tin, sand and gravel, copper, pyrites.
La Plata	544	565	Sand and gravel, stone.
Larimer	19,122	W	Cement, sand and gravel, stone, lime, gypsum, beryllium.
Las Animas	W	98	Sand and gravel, clays.
Lincoln	65	W	Sand and gravel.
Logan	W	W	Lime, sand and gravel, stone.
Mesa	W	W	Sand and gravel, vanadium.
Mineral	W	W	Silver, lead, zinc, copper, stone.
Moffat	W	W	Sand and gravel, vanadium, stone.
Montezuma	W	W	Sand and gravel, carbon dioxide.
Montrose	27,314	W	Vanadium, sand and gravel, salt.
Morgan	W	W	Lime, sand and gravel, stone.
Otero	W	429	Sand and gravel.
Ouray	3,116	1,686	Zinc, lead, silver, copper, sand and gravel, gold.
Park	W	W	Peat, silver, gold, lead.
Phillips	46	22	Sand and gravel.
Pitkin	W	W	Iron ore, sand and gravel.
Prowers	140	W	Sand and gravel, stone.
Pueblo	W	W	Lime, sand and gravel, clays.
Rio Blanco	W	357	Sand and gravel, stone.
Rio Grande	W	W	Sand and gravel.
Routt	432	422	Do.
Saguache	W	--	
San Juan	15,883	W	Gold, zinc, lead, silver, copper.
San Miguel	W	W	Vanadium, zinc, lead, gold, copper, silver, sand and gravel.
Sedgwick	W	W	Lime, sand and gravel.
Summit	800	1,011	Sand and gravel, stone, silver, gold.
Teller	W	W	Peat, sand and gravel.
Washington	32	23	Sand and gravel.
Weld	W	W	Sand and gravel, lime, stone.
Yuma	378	373	Sand and gravel.
Undistributed[1]	[r]165,100	274,526	
Total[2]	[r]537,540	641,826	

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed".
[1] Includes gem stones and values indicated by symbol W.
[2] Data may not add to totals shown because of independent rounding.

Leasing Act of 1920, States receive 50% of bonuses, royalties, and rentals received from mineral leasing revenues. In addition, Colorado counties also received $6.8 million in lieu of property taxes for nontaxable Federal lands within county boundaries.

More than 142,000 unpatented mining claims staked on Federal lands in Colorado were recorded by the October 22, 1979, deadline set by the Federal Land Policy and Management Act of 1976.

The Colorado School of Mines was one of 11 western schools selected as locations for mineral institutes with funding from the Office of Surface Mining.

Bills the Colorado Legislature passed in

Table 3.—Indicators of Colorado business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force .... thousands..	1,252.0	1,309.0	1,335.0	+5.8
Unemployment .... do....	78.0	72.0	66.0	–8.3
Employment (nonagricultural):				
Mining[1] .... do....	24.0	27.3	30.2	+10.6
Manufacturing .... do....	152.8	168.2	180.2	+7.1
Contract construction .... do....	61.8	72.6	80.3	+10.6
Transportation and public utilities .... do....	62.6	70.8	76.0	+7.3
Wholesale and retail trade .... do....	265.0	282.3	298.7	+5.8
Finance, insurance, real estate .... do....	61.7	68.4	74.5	+8.9
Services .... do....	209.1	226.4	241.4	+6.6
Government .... do....	221.1	234.0	236.1	+0.9
Total nonagricultural employment[1] .... do....	1,058.1	1,150.0	[2]1,217.4	+5.9
Personal income:				
Total .... millions..	$18,874	$21,673	$27,195	+14.4
Per capita	$7,190	$8,116	$8,945	+10.2
Construction activity:				
Number of private and public residential units authorized	37,281	[3]46,285	39,232	–15.2
Value of nonresidential construction .... millions..	$431.2	$516.4	$667.2	+29.2
Value of state road contract awards .... do....	$135.0	$78.0	$122.9	+57.6
Shipments of portland and masonry cement to and within the state .... thousand short tons..	1,445	1,559	1,555	–3
Nonfuel mineral production value:				
Total crude mineral value .... millions..	[r]$537.5	$641.8	$826.1	+28.7
Value per capita, resident population	[r]$205	$240	$298	+24.2
Value per square mile	[r]$5,156	$6,157	$7,924	+28.7

[p]Preliminary. [r]Revised.

[1]Includes coal, natural gas, and petroleum.

[2]Data do not add to total shown because of independent rounding.

[3]Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

the 1979 session, the longest in the State's history, included a number of particular interest to mining:

S.B. 149 - Changes the law regarding public availability of mined land reclamation permits.

S.B. 368 - Makes miscellaneous changes in metal mining laws.

S.B. 1153 - Requires that mineral rights holders be notified before subdivision plats are approved.

S.B. 1586 - Makes technical changes in the requirements for recording severed mineral interests.

Completed in 1978, the Roadless Area Review and Evaluation (RARE II) study by the U.S. Forest Service surveyed nearly 6.5 million acres of land in Colorado for possible designation as an wilderness area. Recommended were removal of 1.9 million acres for wilderness area and further study of another 0.5 million acres. The U.S. Bureau of Mines and the U.S. Geological Survey are appraising these lands as well as some Bureau of Land Management lands for mineral potential. Much of the land recommended for wilderness designation is in the mountain area of the Colorado Mineral Belt which extends from Boulder in north-central Colorado to the San Juan Mountains in southwest Colorado.

The U.S. Bureau of Mines signed an agreement in 1979 with Multi Mineral Corp. to mine nahcolite through use of a 2,371-foot shaft sunk by the Bureau of Mines in the thick oil shale deposits of the Piceance Basin in western Colorado. Public Service Co. of Colorado and the Electric Power Research Institute will test the nahcolite as a scrubber to remove sulfur dioxide from combustion gases at coal-fired electric power plants.

In January 1978, the Bureau of Reclamation began evaluating alternative means of treating or controlling water discharge from the the Leadville drainage tunnel into the Upper Arkansas River. The recommended action was to plug the tunnel, which the U.S. Bureau of Mines constructed in 1943 and 1953, at about midway in its 9,000-foot length. The discharge water contains cadmium, copper, iron, manganese, and zinc.

In 1978, the Colorado State Government developed a pioneering process to evaluate the environmental socioeconomic aspects of AMAX Inc.'s Mt. Emmons molybdenum project near Crested Butte. The Colorado Review Process (CRP) involves all Federal, State, and local agencies and the public in the mine planning and development.

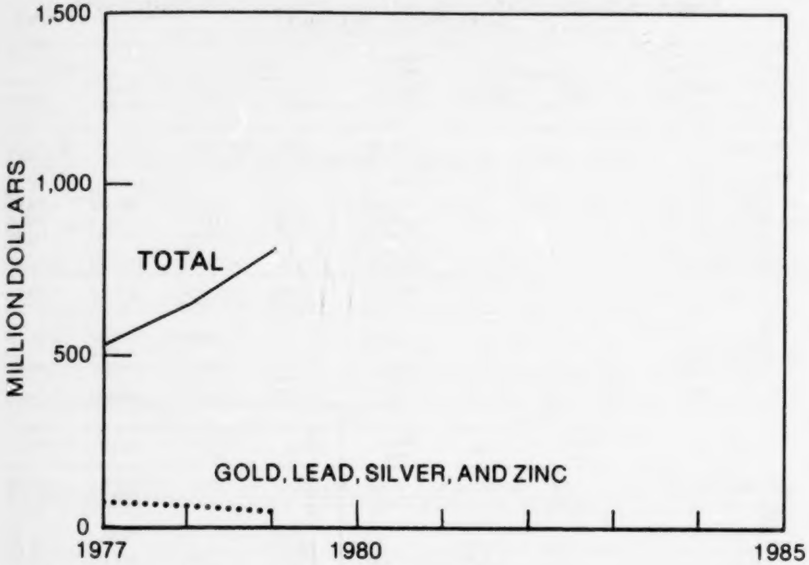

Figure 1.—Value of mine production of gold, lead, silver, and zinc, and total value of nonfuel mineral production in Colorado.

AMAX has worked with the CRP through 1978-79 in examining and developing its Mt. Emmons prospect.

A major controversy in the 1977 Legislature was over Senate Joint Resolution 3, which eliminated some rules and regulations of the Mined Land Reclamation Board (MLRB) controlling reclamation of mined land in the State. Both houses of the Legislature adopted the resolution in 1978. Although legislators argued that the Governor did not have authority to act on the measure because it was a resolution and not a bill, Governor Lamm "vetoed" it. Created by the Legislature, with members appointed by the Governor, the MLRB split on which set of conflicting orders to follow.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Cadmium, Indium, and Thallium.—ASARCO Inc., recovered cadmium, indium, thallium metal, and thallous sulfate at its Globe smelter in Denver from flue dust, dross, and byproduct materials received from out-of-State smelters. The output was not included in the State mineral production because the origin of the processed materials could not be determined. Cadmium is contained in some zinc ores mined in Lake, Ouray, San Juan, and San Miguel Counties.

Copper.—The production of copper in this biennium continued the declining trend of recent years, with 1979 production less than one-third that of 1978. This decline was in spite of a price increase from about $0.66 per pound in 1978 to $0.93 per pound in 1979. The closing, in mid-1978, of Idarado Mining Co.'s Idarado Mine in Ouray and San Miguel Counties, which had been the State's largest producer of copper, was the major factor in this decline.

Standard Metal Corp.'s Sunnyside Mine, located in San Juan County north of Silverton, was the second largest producer of copper in the State in 1977-78. The Sunnyside suffered a crippling flood in June 1978, and did not return to production until the early fall of 1979, ranking fifth in copper

Table 4.—Colorado: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing[1]		Material sold or treated[2] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1977, total	18	1	1,108,258	72,668	$10,777,391	4,663,496	$21,545,332
1978:							
Chaffee	1	--	1	--	--	72	389
Eagle	1	--	7,981	736	142,453	203,509	1,098,949
Ouray	1	--	26,059	576	111,485	19,768	106,747
San Miguel	1	--	154,153	3,407	659,425	116,942	631,487
Summit	1	--	2	1	194	50	270
Undistributed[3]	14	1	545,976	27,374	5,298,239	3,876,840	20,934,934
Total	[4]18	1	734,172	32,094	6,211,796	4,217,181	22,772,776
1979:							
Park	1	--	2,722	96	29,520	9,394	104,179
Summit	1	--	1	--	--	21	233
Undistributed[5]	13	1	408,750	13,754	4,229,359	2,799,519	31,046,666
Total	15	1	411,473	13,850	4,258,879	2,808,934	31,151,078

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1977, total	1,720	$2,533,264	20,860	$14,118,462	36,530	$27,703,651	$76,678,120
1978:							
Chaffee	--	--	(6)	218	--	--	607
Eagle	234	343,058	52	38,257	--	--	1,622,717
Ouray	73	107,474	618	458,746	1,031	704,144	1,488,596
San Miguel	434	635,769	3,652	2,713,771	6,094	4,165,456	8,805,908
Summit	--	--	--	--	--	--	464
Undistributed[3]	451	660,490	10,829	8,045,608	15,083	10,308,307	45,247,578
Total	[7]1,191	1,746,791	15,151	11,256,600	22,208	15,177,907	57,165,870
1979:							
Park	(6)	31	(6)	792	--	--	134,522
Summit	--	--	(6)	261	--	--	494
Undistributed[5]	362	742,089	7,554	8,765,601	9,910	8,149,288	52,933,003
Total	362	742,120	7,554	8,766,654	9,910	8,149,288	53,068,019

[1] Operations from which gold, silver, copper, lead, or zinc were recovered as byproducts from sand and gravel or cleanup are not counted as mines.

[2] Does not include gravel washed.

[3] Includes Boulder, Clear Creek, Gunnison, Jefferson, Lake, Mineral, Park, and San Juan Counties, combined to avoid disclosing company proprietary data.

[4] Detail will not necessarily add to total shown because some mines operated in more than one county, but were counted only as one mine.

[5] Includes Boulder, Eagle, Gilpin, Gunnison, Lake, Mineral, Ouray, Pueblo, San Juan, San Miguel, and Teller Counties combined to avoid disclosing company proprietary data.

[6] Less than 1/2 unit.

[7] Data do not add to total shown because of independent rounding.

production that year. The third major copper producer in the State, the Eagle Mine at Gilman in Eagle County, operated by New Jersey Zinc Co., significantly reduced production in January 1978, because of declining profitability resulting from decreases in base metal prices and rising labor costs. The other two large copper producers, the Bulldog Mountain Mine of Homestake Mining Co. at Creede, Mineral County, and the Leadville unit of ASARCO Incorporated, at Leadville, Lake County, also produced less copper in 1979; however, they did not undergo the drastic reduction that affected Eagle, Idarado, and Sunnyside mines. Copper production was recorded at four smaller mines in 1978 and seven smaller mines in 1979.

Federal Resources Corp.'s Camp Bird Mine in Ouray County suspended operation in August 1977; and although the mine was maintained on a limited standby basis, it had no production in 1978 or 1979.

Copper, produced as a byproduct from base metal ores in lode mines, is the least important of the five major metals produced from these ores in Colorado. Colorado's copper production is less than 0.1 of 1% of the Nation's total.

Gold.—The very substantial decline in gold production in 1978-79, with production levels each year less than half that of 1977, resulted from a natural disaster in 1978 at-

Table 5.—Colorado: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
1978					
Lode:					
Amalgamation and cyanidation[1]	908	190,709	--	--	--
Smelting of concentrates	30,361	3,822,377	957	15,098	22,208
Direct smelting of ore	743	204,095	234	53	--
Total	32,012	4,217,181	1,191	15,151	22,208
Placer	82	--	--	--	--
Grand total	32,094	4,217,181	1,191	15,151	22,208
1979					
Lode and placer:					
Amalgamation, cyanidation, direct smelting of ore[1] [2]	1,295	279,320	189	65	--
Smelting of concentrates	12,555	2,529,614	713	7,489	9,910
Total	13,850	2,808,934	362	7,554	9,910

[1] Combined to avoid disclosing company proprietary data.

[2] Includes placer production.

Sunnyside Mine. In addition, because most gold production in Colorado is a coproduct of base metal production, unfavorable market conditions for other metals effected the cutting back or closing of operations in several large mines. The unprecedented increase in price for gold, from an average of $148.31 per troy ounce in 1977 to $193.55 per troy ounce in 1978 and $307.50 per troy ounce in 1979, was not enough to offset the effects of less favorable prices for coproduct metals and rising production costs at a number of mines.

The Sunnyside Mine operated by Standard Metals, Inc., near Silverton, San Juan County, continued to be the largest source of gold in the State in 1978, and Asarco, Inc.'s Leadville Unit at Leadville, Lake County, was second. The Idarado Mining Co. Idarado Mine in Ouray and San Miguel Counties was third in level of output. These three mines produced more than 90% of the State's gold output in 1978. Sunnyside and the Leadville Unit were again numbers one and two in output in 1979 but with their order reversed—Sunnyside producing at a greatly reduced level. Output of the leading two mines was 85% of total output in 1979. The Idarado did not produce in 1979. Sixteen lode mines in 10 counties produced gold in 1978 while 11 mines in 8 counties produced gold in 1979. Reflecting the small size and evanescence of many gold mining operations in the State, only 7 mines recorded output in both years. Two small placer operations recorded gold production in each year of the biennium. Among the other mines producing gold in 1978-79, in order of output, were the Eagle Mine of New Jersey Zinc Co. at Gilman, Eagle County; Hendricks Mining Co.'s Cross Mine above Nederland, Boulder County; and the Sherman Tunnel operated by Day Mines, Inc., near Leadville in Lake County.

The State's largest gold producer, Standard Metal Corp.'s Sunnyside Mine, one of the vein-mining operations not having cash flow problems, was flooded out on June 4, 1978. The mine, north of Silverton in Cement Creek Canyon, employed about 200 persons working day and swing shifts, 5 days per week. The flooding occurred on a Sunday when no one was in the workings and resulted in no loss of life. Silt and debris blocked the 2-mile-long American Tunnel, which enters the mine from Cement Creek at 10,600 feet elevation, and the 1-mile-long Terry Tunnel which enters the mine from Eureka Creek at 11,500 feet elevation. The main hoisting equipment was completely buried, and much timbering torn out; but most of the mining equipment— including locomotives, ore cars, and digging equipment—was unharmed. An estimated 5 to 10 million gallons of silt- and tailings-laden water poured down 1,000 vertical feet or more through the workings to the American Tunnel haulage level and 2 miles out into Cement Creek when the bed of Lake Emma, which was above the mine at 12,300 feet elevation, collapsed into the present working and an old stope. Standard had mined to within 85 feet of the bottom of Lake Emma but had ceased that operation pending draining of the lake after the spring runoff.

A potential problem in financing reopening of the mine was resolved through the courts, and a claim settlement with the mine insurors was made. Cleanup, under-

Table 6.—Colorado: Mine production (recoverable) of gold, silver, copper, lead, and zinc by class of ore or other source material

Source	Number of mines[1] [2]	Material sold or treated[3] (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
1978							
Lode ore:							
Gold and gold-silver[4]	7	5,429	803	19,726	2	15	12
Silver[5]	5	265,156	1,160	3,615,585	350	2,478	805
Total	11	270,585	1,963	3,635,311	352	2,493	817
Copper-lead-zinc[4]	1	180,212	3,983	136,710	507	4,270	7,125
Lead and lead-zinc[4]	7	283,375	26,066	445,160	333	8,388	14,266
Total[6]	7	463,587	30,049	581,870	839	12,658	21,391
Total lode	17	734,172	32,012	4,217,181	1,191	15,151	22,208
Placer	1	--	82	--	--	--	--
Grand total	18	734,172	32,094	4,217,181	1,191	15,151	22,208
1979							
Lode ore and placer:							
Gold and gold-silver[1] [7]	5	5,821	634	25,275	2	16	73
Silver[5]	5	241,410	1,206	2,512,260	283	1,831	924
Total	9	247,231	1,840	2,537,535	285	1,847	997
Lead, lead-zinc, and zinc[4]	6	164,241	12,010	271,399	78	5,707	8,913
Grand total[6]	15	411,472	13,850	2,808,934	362	7,554	9,910

[1] Detail will not necessarily add to totals shown because some mines produce more than one class of material.

[2] Operations from which gold and silver are recovered as byproducts from sand and gravel operations or cleanup are not counted as producing mines.

[3] Does not include gravel washed.

[4] Ore classes combined to avoid disclosing company proprietary data.

[5] Includes silver tailings.

[6] Data may not add to totals shown because of independent rounding.

[7] Includes placer production.

taken immediately, continued through 1979 and by November the mine was back in operation, producing about 300 tons of ore per day. The ore was stockpiled because the Standard Metals Mill reopening had been delayed by a strike at Westinghouse Electric Corp. which was supplying some of the equipment for the mill. The stockpile had reached more than 10,000 tons by the end of 1979. Standard Metals estimated the value of available broken ore in the mine at the time of the flood to be more than $20 million at current prices for gold, lead, silver, and zinc; two-thirds of this value was in gold. Sunnyside Mine grossed $10 million in 1977. The mine also lost 9 days in May of 1979 before the flood in a worker walkout over wages.

In other developments, the higher price for gold broadened interest in reevaluating old mines and exploration of new areas with a potential for gold. However, general lack of milling and smelting facilities in the State is a potential deterrent to small mine development.

Among the several new mills proposed during the biennium, was a 200-ton-per-day mill in Chaffee County by Eureka Saturday Night Corp. In late 1979, Moritz Mining Co., Inc., purchased the Golden Gilpin ore mill north of Blackhawk.

Rio Grande Mineral Development Corp. planned to develop 3,000 acres of Colorado gold properties scattered along the Continental Divide. A 12-acre parcel near LaVeta was proposed as the site of a leaching plant.

Resources International Corp. evaluated porphyry gold in Boulder County and planned to reopen three small gold mines: the Inexco, Black Rose, and Ramsey. A Toronto firm deep-core drilled in the Jamestown area.

In the Cripple Creek district, Cripple Creek Gold Production Corp. reactivated the Mary Nevin Mine to produce 25 to 100 tons per day and leased an adjacent 20-acre property for further development. A shaft was sunk to the 410-foot level, and crosscuts were started into areas of gold potential. A 100-ton-per-day mill was installed in mid-1979. In October 1979, Cripple Creek Gold Production signed a joint venture agreement with Crown Central Petroleum of Baltimore, Md., to provide working capital and to develop adjacent properties held by Crown Central. In October 1979, Gold Ray Mining Co. planned a gold leaching operation on the south slope of Copper Mountain north of Cripple Creek as did Newport Minerals with its Globe Hill leaching project at Cripple Creek. Golden Cycle and Texasgulf, Inc., spent more than $5 million in exploration of the 3,000 acres, 70% or so of the "contact" area—5,000 acres in the structural basin or caldera which constitutes the Cripple Creek mining district—and deeper exploration through the rehabilitation of the old Ajax Mine. Texasgulf withdrew from the partnership in early 1979 after concluding that the gold ore was insufficient to justify the large-scale (2,000 to 4,000 tons per day) production it wanted. Yellow Gold of Cripple Creek, an exploratory company, worked on the Virgin Shaft of the old Rittenhouse Mine and drifted from the Moffat Tunnel to the seventh level of the mine. In December 1978, the company brought the property the controls the entrance to the Moffat Tunnel and thus gained access to a number of workings including the Dolly Varden property in Squaw Gulch, which the company leases.

Colorado ranked fifth in the Nation in gold production in 1978 with 3% of national production and ninth in the Nation in 1979 with 1.5% of the total.

Iron Ore.—The State's only producer of iron ore was the Cooper Mine near Ashcroft and Aspen, in Pitkin County. Operated by Morrison-Knudsen Co., Inc., for the Pitkin Iron Corp., the mine produced a magnetite ore containing about 65% iron; the entire output was shipped to the Pueblo steel mill of the CF&I Steel Corp. The ore was trucked to a railhead at Woody Creek and then sent by rail down the Roaring Fork River valley to the Denver & Rio Grande Western Railroad line at Glenwood Springs. Indicated output in each of 1978 and 1979 rose by about one-third over that of 1977 as it has yearly since about 1974. Colorado was 10th among the Nation's States which produced iron ore in 1978.

Lead.—As with the other base metals with which it is associated, lead production in Colorado continued to decline in 1978-79. Output in 1978 was less than three-fourths the level of production in 1977, while production in 1979 was only about one-half that of 1978. This shortfall resulted when operations at several major base metal mines were either reduced or closed down. Unfavorable market conditions and rising costs of operation were responsible for unprofitability at these mines, and one, the Sunnyside Mine of Standard Metals, Inc., near Silverton, was closed by natural disaster in mid-1978. Asarco Inc.'s Leadville Unit at Leadville in Lake County continued to be the major producer of lead in Colorado in 1978-79, as it was in the preceding 2 years. The Idarado Mine at Telluride in Ouray and San Miguel Counties, operated by the Idarado Mining Co., a subsidiary of Newmont Mining Corp. and others, was second in production in 1978; however, the mine was closed later that year and contributed nothing to 1979 production. The Idarado had been Colorado's largest producer of lead in 1974. Third in order of production in 1978 was Standard Metals, Inc.'s Sunnyside Mine near Silverton. Irrespective of the disaster in mid-1978, it was still fourth in production in 1979. The Bulldog Mountain Mine, Homestake Mining Co., at Creede, was fourth largest producer in 1978 and second in 1979. The Sherman Tunnel of Day Mines, Inc., at Leadville was sixth in production in 1978, and third in 1979. The three major mines produced nearly 80% of Colorado's lead output in 1978, three mines, one of which was also a front-runner in 1978, produced more than 95% in 1979. Sixteen mines produced lead in Colorado in 1978 and 14 mines produced lead in 1979; 9 mines produced lead in both years. Colorado ranked third in the Nation in production of lead in both 1978 and 1979, with nearly 1.5% of the Nation's total output in 1978 and 3% in 1979.

Molybdenum.—Molybdenum continued to be the most valuable nonfuel mineral produced in Colorado in 1978-79. All the primary molybdenum production in Colorado was by one company, Climax Molybdenum Co., a division of AMAX Inc., from two mines, the Climax Mine near Leadville in Lake County and the Henderson Mine near Empire in Clear Creek County. The output of 92 million pounds of molybdenum concentrate which AMAX reported for 1979 compares with 84 million pounds in 1978 and 75 million pounds in 1977. All of the growth in output reflects the development of the Henderson Mine; 1978 and 1979 were its second and third full years of production. Output was 24 million pounds of molybdenum concentrate in 1977, 32 million pounds in 1978, and 43 million pounds in 1979. Henderson is scheduled to reach its design capacity of 50 million pounds annually by the end of 1980. More than 60% of the Nation's molybdenum output originated in Colorado.

A continuing shortage in the worldwide supply of molybdenum, as well as the effects of inflation on building new mines and operating existing mines, was reflected in the rising average price of molybdenum concentrate from $3.60 per pound in 1977 to $4.65 in 1978 and $6.07 for molybdic oxide in 1979. About 25% of the Nation's output of molybdenum was exported in 1978-79. AMAX's production of molybdenum in Colorado was enough to supply the total U.S. consumption need of 69 million pounds in 1978 (70 million pounds in 1979) plus 15 million pounds (22 million pounds in 1979) toward the rest of the world's consumption of 109 million pounds in 1978 (108 million pounds in 1979). AMAX transports the molybdenum concentrates produced in Colorado to its conversion plants in Langeloth, Pa.; Fort Madison, Iowa; Rotterdam, Holland; Monferrato, Italy; and Stowmarket, England, where it is converted into such products as technical molybdic oxide, ferro molybdenum, ammonium molybdate, and molysulfide powders.

Discovery of the molybdenum ore body and staking of the first claim on Bartlett Mountain, the site of the Climax Mine, occurred in 1879. Although the ore was correctly identified in 1900, a marketable use for molybdenum was not developed until 1918. Climax has been operated as an underground mine since 1918, supplemented by an open pit since 1973. Even a near-record snowfall in 1978 did not prevent the pit, at nearly 11,000 feet elevation from operating year-round. Annual production from the Climax Mine of just over 16 million tons of ore in 1978-79, an average rate of 47,000 tons per day, was from two underground levels: the Storke—21,000 tons and the 600 level—8,000 tons, and from the open pit—18,000 tons. The company anticipated Storke-level ore reserves will be exhausted by 1985; however, by the time Storke production has been phased out, the 600-level and open pit tonnage will have increased to 24,000 tons per day to maintain a 48,000-ton-per-day output. In 1979, the Storke level north-hanging-wall haulage drift connection into the open pit core zone allowed for a supplemental ore-loading point. Grade of ore produced was about 0.30% molybdenum disulfide (MoS_2), 0.021% tungsten, and 0.006% tin. Plant recovery averaged about 87% of the molybdenum and 26% of the tungsten.

Added capital investment in the mine in 1978 was about $15 million. The Mayflower tailings facility, a $36.5 million project begun in 1974 and completed in 1978, has a design capacity of 525 million tons of waste. Together with the 70 million tons of capacity remaining in the existing tailings ponds, the combined facility is expected to serve the mine through its anticipated life—about 2015. An ion-exchange wastewater treatment plant for removing heavy metals from discharge water to meet Environmental Protection Agency (EPA) quality guidelines was also completed in 1978. Work was begun in 1979 on the No. 6 crusher complex to facilitate handling open pit ore and on a new conveyor system. Capital expenditure in 1979 was $70 million.

Proven and probable ore reserves estimated in 1979 were 290 million tons of 0.310% molybdenum disulfide (MoS_2) ore minable by the underground block caving method currently used, and 158 million tons of 0.305% MoS_2 that could be mined by open pit—a 30-year reserve, at the present scale of mining. Delineation of the ore body at Climax to date has required more than 165 miles of exploratory drilling, with holes ranging from 200 feet to more than 8,000 feet in depth. The full extent of the ore body has yet to be defined. The payroll at Climax in 1978 was $53.7 million with an average 2,850 employees. More than $4.6 million in taxes was paid to Lake and Summit Counties for that year.

In contrast to the Climax Mine, the Henderson Mine is entirely underground, as deep as 4,500 feet in an ore body located in Red Mountain below the Urad ore body which AMAX completed mining in 1974. Production has grown from 4.5 million tons of ore in 1977, to 6.9 million tons in 1978, to 9.4 million tons in 1979. Proven and probable ore reserves are calculated at 260 million tons averaging 0.419% MoS_2. Although the full extent of the mineralized zone has not been fully defined, preliminary drilling and geological analysis indicate an additional 154 million tons of mineralized material averaging 0.362% MoS_2. In 1978, $24 million was spent on capital expenditures at Henderson and in 1979, $54 million, bringing total project spending since 1964 to $624 million, including capitalized interest. The mine is reportedly the largest private investment ever undertaken in Colorado. A work force of about 1,700 was employed in the mine and in the mill to which ore is carried by automated railway through a 9.3-mile tunnel under the Continental Divide.

A full-scale program to stabilize and reclaim about 160 acres of surface area related to the now closed Urad Mine was nearing completion after five seasons of revegetation and reclamation. Because of the high altitude and short growing season, minor vegetation maintenance will be required for approximately 10 more years. The Urad reclamation project will cost AMAX between $6 and $7 million by the time it is finished, more than three times the $2 million paid for the property in 1961.

AMAX continued its evaluation and feasibility studies begun in 1974 at the Mount Emmons Prospect near Crested Butte. In 1978, the company announced that preliminary drilling and geological estimates indicated an ore body containing 165 million tons of mineralized material averaging about 0.43% MoS_2. A decision to mine the deposit could result in an underground mine employing 1,200 to 1,400 persons producing 20,000 tons of ore, and 50 tons of molybdenum per day. In evaluating and planning the project, AMAX worked with local, State, and Federal agencies and groups through the Colorado Review Process or CRP, a concept developed in 1978.

Silver.—Eighteen mines produced silver in Colorado in 1978, 14 mines producing silver in 1979. Ten mines reported production of silver in both years. With the price of silver increasing from an average $5.40 per troy ounce in 1978 to $11.09 per troy ounce in 1979, silver assumed the leading role in value of the coproduct or byproduct production of base and precious metals—copper, gold, lead, silver, and zinc—in Colorado. More than one-half the values produced from these ores in 1979 was credited to silver. Nevertheless, the quantity of silver produced in 1979 was just two-thirds that produced in 1978. The major producer of silver in the State in 1978-79 continued to be the Bulldog Mountain Mine of Homestake Mining Co. at Creede in Mineral County. Second in rank in both years was the Sherman Tunnel near Leadville in Lake County operated by Day Mines, Inc., under a lease agreement with Leadville Corp. No other mine produced as much as one-fourth the silver each of these mines did. The Leadville Unit of Asarco, Inc., at Leadville, Lake County, however, was an important silver producer in both years, as was the Eagle Mine of New Jersey Zinc Co. at Gilman in Eagle County. The Sunnyside Mine of Standard Metals, Silverton, San Juan County, and the Idarado Mine, Idarado Mining Co., Ouray and San Miguel Counties, each produced over 100,000 ounces of silver in 1978. However, Sunnyside's June 1978 flood and closing of the Idarado in October 1978, dropped them from the list of major producers in 1979. The two largest producers accounted for 80% or more of total silver output in both years.

Lower prices for some of the coproducts of silver in recent years have been a factor in silver production, but higher prices for silver have stimulated increased exploration for silver prospects. In August 1978, an agreement between Minerals Engineering Co. of Denver and Chevron, USA, gave Chevron exploration rights plus purchase and joint venture options on about 2,000 acres of patented mining claims near Creede. The 2,000 acres involved are adjacent to Homestake Mining Co.'s Bulldog Mine, the State's largest silver producer. Bear Creek Mining Co., the exploration arm of Kennecott Corp., leased from Sierra Resources, Inc., the Tip Group of claims in Clear Creek and Summit Counties in an area of lead-silver deposits.

Following a 2-year evaluation program, Mineral Resources Development, Inc., began mining the Silver Wing Mine in Montezuma, Colo., in April 1978. Their "Montezuma Project"—a silver, lead, zinc, and gold property—includes a 75-ton-per-day mill.

Colorado was third in the Nation in silver production in 1978 with 11% of the national total, fourth in 1979 with 10% of national output.

Tin.—Colorado remained the Nation's major producer of tin in terms of value in 1978-79. News releases indicate production of about 180,000 pounds of tin annually as a byproduct of molybdenum production at AMAX Inc.'s Climax Mine near Leadville in Lake County. The ore mined at Climax contains about 0.006% tin.

Tungsten.—Colorado was second among the eight States which produced tungsten in 1978-79; California was the other significant producer. The Climax Mine of AMAX Inc. was the only mine with reported output of tungsten in Colorado in the biennium. News releases indicated about 1.8 million pounds of tungsten was produced each year as a byproduct of molybdenum output at Climax where ores run about 0.30% molybdenum and 0.021% tungsten. Plant recovery was estimated to average about 26% of the contained tungsten. Smaller tungsten producers in Boulder and San Juan Counties did not report any production for 1978 or 1979.

Vanadium.—Colorado was first in the Nation in production of vanadium in 1978-79. Vanadium was produced as a coproduct with uranium; most production occurred in the uranium belt in the Colorado Plateau area of southwestern Colorado. Montrose and San Miguel Counties were the leading sources in the State; minor amounts were produced in Mesa and Moffat Counties. Uranium-vanadium ore that provided the mill feed to various mills in the State averaged 5 pounds of vanadium oxide (V_2O_5) for each 1 pound of uranium oxide (U_3O_8) contained.

Using a modified vat heap-leach method, Ranchers Exploration and Development Corp. recovered vanadium and uranium from old tailings at Naturita, Colo. About 1,600,000 pounds of V_2O_5 were recovered from 600,000 tons of tailings in 1978-79, about 4,600 pounds of V_2O_5 daily. With three leach tanks for a three-stage co-current sulfuric acid-leach and solvent extraction system, the plant was designed for close siting to the tailings and for economic resiting to other old tailings disposal sites once the Naturita pile was exhausted.

Plans to move this plant to a site near Durango in early 1979 to process about 1.4 million tons of uranium tailings there were stalled by failure to obtain a license from the Colorado Department of Health.

Zinc.—Zinc has historically been the most important of the metals extracted from Colorado's base metal ores. In the past 5 years, however, it has declined not only in absolute value and output, but in value relative to the other metals of this group. In 1977, zinc comprised 36% of the value of all metals produced from base metal ores in Colorado; in 1978, 27%; and in 1979, 15%. In 1978 it was exceeded in value by silver and in 1979 was exceeded in value by silver and lead. The price of zinc, which was $0.39 per pound in 1975, fell to $0.37 per pound in 1976, (and reached a 4-year low of $0.344 per pound during that year), remained at about $0.37 through 1978, and fell to an average $0.31 per pound in 1979.

Production of zinc in the State declined 20% from 1976 to 1977, 39% in 1978, and a further 55% in 1979. The basic factors in declining zinc production over the longer term have been unfavorable prices and rising costs of production and the consequent closing or reduction in output of several large mines in the State. The major factor in the decline of zinc production in the 1978-1979 period in Colorado was the closing of the Idarado Mine in Ouray and San Miguel Counties at the end of October 1978. Owned by the Idarado Mining Co., a subsidiary of Newmont Mining Corp., and others, the Idarado was one of the largest and oldest base metal and precious metal mines in Colorado. Early claims at the site go back as early as 1880, and this closure ends nearly a century of production. The mine was an amalgamation of several old mines, including the Smuggler-Union, Tomboy, and Liberty Bell; it stretched 6 1/2 miles through Red Mountain from Red Mountain Pass between Ouray and Silverton to the head of the box canyon that surrounds Telluride. Its headquarters was at Ouray; its mill at Telluride; and concentrates were shipped to Pennsylvania, British Columbia, Canada, and Arizona for smelting. It has been known by the name Idarado since 1953. The mine will be on indefinite-care and maintenance status and its equipment removed; about 20 employees will remain. Copper, gold, lead, silver, and zinc were recovered from Idarado ores. Zinc accounted for 60% of the production. Depressed lead and zinc prices and high smelter costs had made the Idarado increasingly unprofitable. It had a net loss of $153,000 in 1976 and $320,000 in 1977. Attempts were made to reduce operating expenses by limiting mining to the most accessible ore in the central part of the mine and by converting from stope mining to room-and-pillar mining which uses more machinery and thus reduces labor requirements to about 150 people. In its last profitable year, 1974, the Idarado produced 400,000 tons of ore, employed nearly 500 people, and had a payroll of $7 million. Reclamation plans for the 30-acre tailings pond near Telluride depend upon whether the mine closure is permanent.

The Eagle Mine, near Gilman in Eagle County, the State's largest producer of zinc for a number of years, ceased its zinc operation January 1, 1978, because of the low price for zinc and because the underhand, square set timbering method used in the mine was too expensive to be competitive. The underground mill ceased operation and has been partly dismantled. Pyritic ore containing copper, gold, lead, and silver was being direct shipped to the Asarco smelter at Tacoma, Wash., for processing. Production at the mine was continued at about a 43-employee, 500-ton-per-month level.

In 1978 eight mines in Colorado reported production of zinc; in 1979 nine mines reported production. The most important producers in 1978 were the Leadville Unit of Asarco Inc., at Leadville, Lake County; the Idarado Mine at Telluride, San Juan and Ouray Counties; the Sunnyside Mine of Standard Metals Corp. near Silverton, San Juan County; and the Bulldog Mountain Mine, Homestake Mining Co. at Creede, Mineral County. In 1979, the Leadville Unit ranked first, Bulldog second, and Sunnyside third. The top two mines produced more than 80% of total zinc output in 1978 and more than 95% in 1979. Colorado was fourth in the Nation in production of zinc in 1977, sixth in 1978, and eighth in 1979 with 7% of the Nation's production in 1978 and 4% of national output in 1979.

NONMETALS

Cement.—Three plants produced cement in Colorado in 1978-79: the Boettcher plant and the Portland plant, both of Ideal Cement Co., a division of Ideal Basic Industries, Inc.; and the Lyons plant of the Dewey Rocky Mountain Cement Co., division of Martin Marietta Corp. All three plants produced portland cement; two of them also produced masonry cement. Although all plants were operated at near capacity during the period because of a sustained high level of new housing activity and increased commercial and industrial construction in Colorado and surrounding States, yearend stocks in 1978-79 were somewhat higher than at the beginning of each year. Cement was the most important nonmetallic mineral in the State in value.

A $24 million program by Ideal to modernize its dry-process plant at Boettcher, begun in 1977, continued through 1978-79. A traveling-grate, preheater kiln will replace two 50-year-old kilns. The specially designed preheater will use the kerogen in the limestone to provide about one-fourth of the fuel needed by the facility and will thus reduce electrical power requirements by 20%, making this one of the most energy efficient plants of its type. A new raw materials handling and blending system and a new raw roller mill are included in the project. When completed in early 1980, the reconstruction program will increase capacity of the plant by 135,000 tons per year to a total of 460,000 tons per year.

Martin Marietta let a $6.8 million contract in August 1979, for converting its long-kiln, dry-process cement plant at Lyons to the SF Process of flash calcining. The plant had been using a 14 foot 3 inch by 17 foot by 490 foot-long rotary kiln. The kiln will be cut to 14 foot 3 inch by 245 feet long; air seals and a raw-material preheater will also be included. The plant's existing direct-coal fired system will be converted to a semidirect system to permit the use of pulverized coal as fuel for both the kiln and flash calciner. After conversion, scheduled for completion in 1980, the Lyons plant will have a rated capacity of 1,250 tons per day.

Clays.—Clays were produced in eight counties in Colorado; six of these were eastern-slope counties in a north-south line along the foothills of the Front Range. Common clay was produced in all eight counties, fire clay in five counties, and bentonite in one county. Common clay was the major type produced. Common brick and face brick were the most common uses of clay, with some minor use in fire brick, flue lining, sewer pipe, and chemicals. Sixteen companies and 53 mines engaged in clay production in the State in 1978. The Robinson Brick and Tile Co. of Denver, operating nine mines, produced about one-half of the clay produced in terms of value. Silver Rocker Bentonite Co. and Lakewood Brick and Tile Co. followed in order of volume of output. The unit value of com-

Table 7.—Colorado: Clays[1] sold or used by producers, by county

(Short tons)

County	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Boulder	W	W	W	W	W	W
Douglas	371,901	$2,238,870	170,508	$1,037,247	96,129	$610,409
Elbert	15,425	100,263	W	W	W	W
El Paso	W	W	W	W	W	W
Fremont	W	W	48,702	210,158	28,401	111,178
Jefferson	W	W	213,708	990,788	228,304	1,079,620
Las Animas	20,000	20,000	W	W	W	W
Pueblo	129,137	290,526	47,723	221,284	54,303	274,601
Other[2]	424,181	2,062,680	66,885	293,986	114,125	641,422
Total	960,644	4,712,339	547,526	2,753,463	521,262	2,717,230

W Withheld to avoid disclosing company proprietary data; included with "Other."

[1] Bentonite is excluded from the data.

[2] Consists of data indicated by symbol W.

mon clay and shale ranged from about $2.00 per ton to $7.00 per ton, fire clays ranged from about $3.70 to $10.80 per ton, and bentonite was about $12.00 per ton.

Feldspar.—Colonna & Co. produced feldspar from pegmatites in the Rampart Range in Fremont County. All produced by hand cobbing, the product was used for decorative aggregate.

Gypsum.—Crude gypsum was produced by three operators in Fremont County and three different operators in Larimer County in 1978. Flintkote Co. dominated the industry in volume of output. Flintkote was the only producer of calcined gypsum in the State with its operation in Fremont County. Calcined gypsum was used in manufacturing building products, principally wallboard material, while crude gypsum was marketed as a soil conditioner and cement retarder.

Lime.—Lime was produced by the Great Western Sugar Co. for use in processing sugar beets in plants in Larimer, Logan, Morgan, Sedgwick, and Weld Counties in the South Platte River valley of northeastern Colorado. By far the largest lime-producing operation in the State in 1978, the CF&I Steel Corp. in Pueblo County produced lime for use in its steel-making operations in that county.

Peat.—Six operations in five counties produced peat in 1978-79; one in Alamosa, one in Boulder, one in Chaffee, one in Park, and two in Teller. All these partly mountainous counties are in central Colorado. The operation in Park County had the largest output in both years.

Perlite.—Crude perlite was produced in Colorado in 1978-79 at one mine, the Rosita Mine of Persolite Products, Inc., in Custer County. Output of the mine was shipped to the company's expanding plant near Florence. Perlite was expanded to two mills in Colorado, the Florence plant in Fremont County operated by Persolite Products, Inc., and the Antonito plant in Conejos County operated by Grefco, Inc. Deposits in New Mexico furnished the crude perlite for the Grefco, Inc., mill.

Expanded perlite was used principally as material for filter aid; nearly 90% in both years. Other uses included concrete, plaster, horticulture aggregate, and low-temperature insulation.

Pumice.—Output of pumice in the form of scoria was reported in both 1978 and 1979 by the Colorado Aggregate Co. at its Mesita Hill operation in Costilla County and by Dotsero Block Co., Inc., at its Dotsero operation in Eagle County. In 1978, output of volcanic cinder was also reported by the Colorado Division of Highways near Basalt in Eagle County. The Costilla County output was processed with nearly 95% used in landscaping and the balance in roofing. All of the Division of Highways product remained in a crude state and was used in highway construction. Seventy-five percent of the Dotsero Block Co. output was processed for use as concrete aggregate, and the remainder for road construction.

Pyrites.—Pyrite was produced in both 1978 and 1979 at the Climax mill of AMAX Inc. near Leadville in Lake County as a byproduct of concentrating molybdenum ore. Three to five pounds of iron pyrite were removed per ton of ore processed. Although the market for pyrite is limited, pyrite must be removed before the tungsten in the ore can be removed. Colorado ranked second of the three States reporting pyrite production in 1978-79; its volume of production, however, was insignificant in comparison with that of the leading State, Tennessee.

Salt.—Salt in the form of brine was recovered from a well in Montrose County by Union Carbide Corp. for use in the company's uranium-vanadium mill at Uravan. Output in 1978 was about 10% greater than in the preceding year.

Sand and Gravel.—Sand and gravel was the third most important nonfuel mineral produced in the State in value of output in 1978, exceeded only by molybdenum and portland cement in total value. Sand and gravel was also the most widely produced mineral commodity in the State, with production occurring in 48 of the 63 counties of Colorado. Four of the counties in which no sand or gravel was produced were prairie counties in southeastern Colorado; most of the remainder were mountain counties in the southwestern part of the State. Sand and gravel was produced by 148 operators at 193 locations. Construction sand and gravel was 99% of total output and industrial sand and gravel was 1%. Nearly 36% of construction sand and gravel was used in road bases and another third in concrete aggregate. Asphalt and fill were the remaining major uses of construction sand and gravel. Nearly three-fourths of industrial gravel output was used as filtration material. Hydraulic fracturing was the major use of industrial sand. Average prices in 1978 were $2.15 per ton for construction sand and gravel and $8.45 per ton for industrial sand and gravel, with an overall average price of $2.21 per ton. Prices ranged from nearly $35 per ton for industrial sand used in blasting to $1.48 per ton for construction sand and gravel used as fill.

Jefferson County, the largest producer in

Table 8.—Colorado: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	8,681	$21,493	$2.48	8,948	$24,205	$2.71	7,441	$21,700	$2.92
Plaster and gunite sands	NA	NA	NA	59	246	4.17	55	223	4.05
Concrete products	337	788	2.34	309	755	2.44	276	563	2.04
Asphaltic concrete	3,060	6,583	2.15	4,482	8,356	1.86	3,888	7,394	1.90
Roadbase and coverings	8,845	16,603	1.88	9,375	17,334	1.85	10,554	20,459	1.94
Fill	1,275	1,473	1.16	1,888	2,800	1.48	2,237	3,525	1.58
Snow and ice control	NA	NA	NA	285	518	1.82	406	783	1.93
Railroad ballast	27	67	2.51	78	196	2.51	32	103	3.25
Other uses	1,685	3,520	2.09	790	1,831	2.31	623	1,516	2.43
Total[1] or average	23,910	50,527	2.11	26,215	56,241	2.15	25,512	56,263	2.21

NA Not available.

[1] Data may not add to totals shown because of independent rounding.

Table 9.—Colorado: Sand and gravel sold or used by producers

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	7,813	$15,761	$2.02	9,069	$18,994	$2.09	8,179	$18,419	$2.25
Gravel	16,097	34,766	2.16	17,146	37,247	2.17	17,333	37,844	2.18
Total or average	23,910	50,527	2.11	26,215	56,241	2.15	25,512	56,263	2.21
Industrial:									
Sand	W	W	W	W	W	W	W	W	W
Gravel	--	--	--	W	W	W	W	W	W
Total or average	W	W	W	279	2,355	8.45	W	W	W
Grand total[1] or average	W	W	W	26,493	58,596	2.21	25,680	[2]56,263	W

W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

[2] Excludes industrial sand and gravel.

the State was followed by Boulder and Adams Counties. All three counties are part of the Denver-Boulder metropolitan area. Eighty-eight percent of sand and gravel produced was shipped to its destination by truck, just 1% by railroad. More than one-half of the sand and gravel operations in the State work deposits containing less than 100,000 tons of sand and gravel material, but more than one-half of the State's output comes from deposits of 100,000 to 400,000 tons. Industrial sand and gravel is produced at just three locations in the State.

Requests for permits to mine sand and gravel generated controversy in a number of counties in 1978-79 with most opposition from residential neighbors of the proposed mining sites. In late 1979, Jefferson County proposed a change in zoning policy for sand and gravel mining which would allow mining as a planned development in existing zoning categories rather than requiring zoning as a mineral conservation district. Within a week or so of each other, a Colorado Court of Appeals ruled that mineral rights to a property did not include sand and gravel deposits, and a U.S. District Judge in Wyoming ruled that gravel is a mineral and protected under mineral rights to a property.

Table 10.—Colorado: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	W	W	W	W	2	5
Poultry grit and mineral food	47	W	--	--	84	253
Concrete aggregate	763	2,123	859	2,559	631	1,977
Bituminous aggregate	271	619	130	353	185	553
Macadam aggregate	W	W	W	W	6	13
Dense-graded roadbase stone	486	771	606	938	641	1,168
Surface treatment aggregate	W	W	W	W	26	62
Other construction aggregate and roadstone	433	1,143	763	1,407	599	1,036
Riprap and jetty stone	258	593	153	341	310	901
Terrazzo and exposed aggregate	W	W	W	W	100	608
Cement manufacture	2,736	6,828	2,992	8,146	3,105	8,866
Lime manufacture	38	104	W	W	23	69
Flux stone	W	W	W	W	648	2,322
Refractory stone	1	W	2	W	W	W
Mine dusting	44	W	W	W	W	W
Sugar refining	64	W	16	92	165	881
Waste materials	--	--	--	--	9	33
Other uses[2]	456	1,987	708	1,848	300	658
Total[3]	5,597	14,169	6,229	15,683	6,835	19,435

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, sandstone, and traprock.

[2] Includes stone used for railroad ballast and manufactured fine aggregate (stone sand).

[3] Data may not add to totals shown because of independent rounding.

Stone.—Crushed stone was produced at 57 quarries in 23 counties of Colorado; dimension stone was produced in 8 quarries in 3 counties. Less than 1% of the total output of stone was dimension stone. More than 80% of the crushed stone output was limestone and nearly one-half of the total output was used in the manufacture of cement. Concrete aggregate, roadstone and roadbase were other important uses whose sum use about equaled that for cement. Crushed limestone was also used for sugar refining, as flux stone in steel manufacture, and for mine dusting. Fifty-one out of the 63 stone producers in the State in 1978 produced less than 25,000 tons per year. The three largest producers—Ideal Basic Industries, Inc.; Cooley Gravel Co.; and Martin Marietta Corp.—produced more than 50% of total output. The five largest stone-producing firms included the State's two cement manufacturers and its one steel mill.

Sulfur.—Continental Oil Co. recovered elemental sulfur from acid gases at its petroleum refinery near Denver. Elemental sulfur was not included in table 1 because it is considered a secondary product.

Vermiculite.—Crude vermiculite from Montana, exfoliated by W.R. Grace & Co. at its plant in Denver, was used for concrete and plaster aggregates, insulation, fireproofing, and horticulture.

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[1] State mineral specialist, Bureau of Mines, Denver, Colo.

Table 11.— Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ideal Basic Industries, Inc.[1]	Box 231 Florence, CO 81226	Plants	Fremont and Larimer.
Martin Marietta Corp.[2]	11300 Rockville Pike Rockville, MD 20852	do	Boulder.
Clays:			
Lakewood Brick & Tile	1325 Jay St. Denver, CO 80214	Mine and plant	Jefferson.
Robinson Brick & Tile Co.	Box 1619 Denver, CO 80223	Mines	Douglas, Elbert, El Paso, Jefferson.
Silver Rocker Bentonite Co	445 Scott St. Salida, CO 81201	do	Fremont.
Gold: Standard Metals Corp.[3]	Box 247 Silverton, CO 81433	Mine and mill	San Juan.

See footnotes at end of table.

Table 11.— Principal producers —Continued

Commodity and company	Address	Type of activity	County
Gypsum:			
The Flintkote Co	400 Westchester Ave. White Plains, NY 10604	Mine and plant	Fremont.
Ernest W. Munroe	101 East Vine Dr. Fort Collins, CO 80521	Mine	Larimer.
Quad-Honstein Joint Venture	1301 Arapahoe St. Golden, CO 80401	do	Do.
U.S. Soil Conditioning Co	Box 336 Salida, CO 81201	do	Fremont.
Iron ore: Pitkin Iron Corp	105 West Adams St. Chicago, IL 60603	Strip mine and plant	Pitkin.
Lead: ASARCO Incorporated[4]	Box 936 Leadville, CO 80461	Mine and mill	Lake.
Lime:			
The Great Western Sugar Co	Box 5308 Denver, CO 80217	Plants	Adams, Boulder, Larimer, Logan, Morgan, Sedgwick, Weld.
CF&I Steel Corp	Box 316 Pueblo, CO 81002	Mine	Pueblo.
Molybdenum: AMAX Inc.[5]	13949 West Colfax Ave. Golden, CO 80401	do	Clear Creek and Lake.
Peat:			
Universal Peat Co	1557 South Ingalls St. Lakewood, CO 80422	Bog	Park.
Ver-Ja Peat Moss	Woodland Park, CO 80863	do	Teller.
Marving Enterprises, Inc	304 Mount View Lane Colorado Springs, CO 80907	do	Do.
Perlite (crude and expanded):			
Grefco, Inc	Box 308 Antonito, CO 81120	Plant	Conejos.
Persolite Products, Inc.[6]	Box 105 Florence, CO 81226	Mine	Custer.
Pumice:			
Colorado Aggregate Co., Inc	Box 106 Mesita, CO 81142	Strip mine and plant	Costilla.
Dotsero Block Co., Inc	Box 933 Glenwood Springs, CO 81601	do	Eagle.
Sand and gravel:			
Cooley Sand & Gravel Co.[1]	Box 313 Pueblo, CO 81002	do	Adams, Arapahoe, and Pueblo.
Golden Gravel Co	Box 328 Longmont, CO 80501	do	Boulder.
Mobile Pre-Mix Sand and Gravel Co	7620 Madison St. Denver, CO 80204	do	Adams and Arapahoe.
Western Paving Construction Co	5105 Washington St. Denver, CO 80216	Pit and plant	Adams.
Flatiron Sand and Gravel Co	Box 229 Boulder, CO 80302	Pits and plants	Boulder and Larimer.
Silver:			
Day Mines, Inc.[7]	Box D Leadville, CO 80461	Mine and mill	Lake.
Homestake Mining Co.[8]	Box 98 Creede, CO 81130	do	Mineral.
The New Jersey Zinc Co.[9]	Gilman, CO 81634	Mine	Eagle.
Vanadium:			
Cotter Corp	Box 352 Golden, CO 80401	do	Fremont and Jefferson.
Union Carbide Corp	270 Park Ave. New York, NY 10017	Mines	Garfield, Mesa, Montrose, San Miguel.
Ranchers Exploration and Development Corp	1776 Montano Rd., NW Albuquerque, NM 87107	Mill	Montrose.
Zinc: Idarado Mining Co.[10]	Ouray, CO 81427	Mine and mill	Ouray and San Miguel.

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[1] Also stone.
[2] Also lime and stone.
[3] Also zinc, lead, silver, and copper.
[4] Also zinc, gold, and copper.
[5] Also pyrites, tin, and tungsten.
[6] Also a plant in Fremont County.
[7] Also lead, zinc, gold, and copper.
[8] Also lead, zinc, and copper.
[9] Also copper, gold, and lead.
[10] Also lead, copper, gold, and silver.

The Mineral Industry of Connecticut

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the State Geological and Natural History Survey of Connecticut, Department of Environmental Protection, for collecting information on minerals, except fuels.

By Doss H. White, Jr.[1] and E. C. Baker[1]

The value of Connecticut's nonfuel mineral production in 1978 and 1979 was $53.6 million and $69.2 million, respectively. Mineral production continued to increase during 1978 and 1979 because of increased output of sand and gravel, stone, and clays, reflecting increased demands by the construction industry. Stone was the most valuable mineral commodity produced in the State, followed by construction sand and gravel, and clay. Feldspar, gem stones, foundry sand, lime, and mica also were produced in the State and contributed to the value of mineral production. Connecticut continued as the second leading producer of feldspar in the United States.

Table 1.—Nonfuel mineral production in Connecticut[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	95	$250	105	$324	112	$435
Lime do	29	1,412	29	1,564	33	2,053
Sand and gravel do	[2]8,543	[2]18,316	11,011	26,557	[2]9,990	[2]23,612
Stone:						
Crushed do	6,980	20,319	7,364	22,301	8,271	38,767
Dimenision do	9	240	9	240	13	475
Combined value of feldspar, gem stones, mica and industrial sand (1977, 1979)	XX	3,171	XX	2,623	XX	3,894
Total	XX	43,708	XX	53,612	XX	69,236

XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Connecticut, by county

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Fairfield	$4,197	$1,994	Sand and gravel.
Hartford	W	W	Stone, sand and gravel, clays.
Litchfield	5,945	9,080	Sand and gravel, stone, lime.
Middlesex	3,362	4,333	Feldspar, sand and gravel, stone, mica, clays.
New Haven	14,354	W	Stone, sand and gravel.
New London	W	W	Sand and gravel, stone.
Tolland	W	W	Do.
Windham	2,061	W	Do.
Undistributed[1]	13,790	38,203	
Total[2]	43,708	53,612	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes gem stones and values indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Connecticut business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force ... thousands	1,500.0	1,519.0	1,581.0	+4.1
Unemployment ... do	106.0	79.0	81.0	+2.5
Employment (nonagricultural):				
Mining ... do	([1])	([1])	([1])	--
Manufacturing ... do	406.7	419.6	435.1	+3.7
Contract construction ... do	[2]43.7	[2]47.9	51.3	+7.1
Transportation and public utilities ... do	55.4	57.8	61.3	+6.1
Wholesale and retail trade ... do	267.3	284.2	297.3	+4.6
Finance, insurance, real estate ... do	90.7	95.2	99.7	+4.7
Services ... do	242.9	262.2	274.7	+4.8
Government ... do	175.6	179.2	181.5	+1.3
Total nonagricultural employment ... do	1,282.3	1,346.1	1,400.9	+4.1
Personal income:				
Total ... millions	$25,019	$27,623	$31,021	+12.3
Per capita	$8,052	$8,915	$9,959	+11.7
Construction activity:				
Number of private and public residential units authorized	15,707	[3]15,851	14,534	-9.3
Value of nonresidential construction ... millions	$281.9	$372.2	$483.8	+30.0
Value of State road contract awards ... do	$128.0	$25.0	$59.0	+136.0
Shipments of portland and masonry cement to and within the State ... thousand short tons	661	784	782	-.3
Nonfuel mineral production value:				
Total crude mineral value ... millions	$43.7	$53.6	$69.2	+29.1
Value per capita, resident population	$14	$17	$22	+29.4
Value per square mile	$8,726	$10,703	$13,822	+29.2

[p] Preliminary.

[1] Included with "Contract construction."

[2] Includes mining.

[3] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Trends and Developments.—About 1,100 of the State's 1 million industrial workers were directly involved in mineral extraction, and approximately 320,000 of the workers were employed in jobs processing mineral raw materials or in industry heavily dependent on mineral-derived products. Located in the State were copper and brass milling operations, brick and glass manufactures, and producers of a host of mineral-based items, such as calcium metal, chemicals, concrete products, cutlery, hardware, machine tools and dies, plastics, silverware, and tools.

Conflicts resulting from the competition for acquisition and use of land between the industrial and private sectors continued. Access to and availability of mineral construction materials was adversely affected by the acquisiton of land for urban development and quarry-operating restrictions enforced by local planning and zoning commissions. However, New Haven Traprock Co.'s plan for the mining of 1 million tons of rock in 1978 was submitted and endorsed by the New Haven Planning and Zoning Commission; a citzen's association petitioned unsuccessfully to a local planning and zoning commission to regulate working hours of a sand producer located in an industrial-quarrying zone.

Legislation and Government Programs.—The State's Coastal Zone Management Program was approved by the Legislature in June 1979 and will receive Federal approval in 1980. The Connecticut Coastal Zone Management legislation will affect resource development, including minerals, in the coastal area.

State officials worked with Federal Bureau of Mines personnel to select areas for Bureau research efforts into abating environmental and disposal problems from metalworking waste. These wastes resulted from metal etching and plating operations.

The Connecticut Geological and Natural History Survey published eight reports related to the State's mineral wealth. Work on State topographic mapping, in conjunction with the U.S. Geological Survey, was completed; the final four maps are scheduled for printing in 1980. Other work, with the U.S. Geological Survey, included the preparation of bedrock and surficial geology maps of the State. Compilation work for the bedrock map was completed in July 1979, and open filing of much of the surficial map has been completed.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—There are no cement-producing plants in Connecticut. Shipments of portland and masonry cement from other Northeastern States into the State increased significantly during 1978 and 1979.

Clays.—Common clay was produced by one company in Hartford County and by another in Middlesex County. This clay was used mainly for building brick and lightweight aggregate manufacture.

Feldspar.—Feldspar is the general name assigned to a group of anhydrous aluminum silicates that are major components in most igneous rocks, and is used in the manufacture of glass and ceramic products. The Feldspar Corp. operated two open pit mines in Middlesex County. The feldspar was trucked to the Middletown facility for grinding and concentrating. Ground feldspar was exported to Canada and also was shipped by rail to various other States for use as a flux in glassmaking and ceramics.

Gem Stones.—Interest in gem and mineral collecting centered in the old Middletown-Portland beryl-mica district and the Roxbury area, where the world's finest gem garnets were once mined. Much of the mineral- and gem-quality material collected in Connecticut was by individuals for personal collections and was not placed on the commercial market.

Lime.—Pfizer, Inc., operated the only lime production operation in the State, in Litchfield County. The ground product was sold for mason's lime, pollution control additives, and other uses. The lime was marketed in Connecticut and other Northeastern States.

Mica.—Scrap and flake mica were recovered as a coproduct of feldspar production at Middletown in Middlesex County. The crude mica was sold to a company in North Carolina, where it was ground and sold to manufacturers of gypsum wallboard and cement.

Sand and Gravel.—Sand and gravel was produced in all eight counties in the State; total production was exceeded only by stone in terms of value. Hartford and New Haven Counties were the leading producers. The major uses were for aggregate, railroad ballast, and foundry sand.

Table 4.—Connecticut: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,220	$8,678	$2.69	3,759	$10,605	$2.82	3,397	$9,409	$2.77
Plaster and gunite sands	NA	NA	NA	26	92	3.61	23	77	3.40
Concrete products	522	1,306	2.50	424	976	2.31	280	684	2.44
Asphaltic concrete	1,340	2,919	2.18	2,056	5,286	2.57	1,804	4,599	2.55
Roadbase and coverings	1,460	2,598	1.78	2,212	4,322	1.95	2,143	4,482	2.09
Fill	1,398	1,588	1.14	1,706	2,224	1.30	1,459	2,196	1.51
Snow and ice control	NA	NA	NA	502	1,115	2.22	669	1,276	2.24
Other uses	609	1,226	2.02	261	796	3.04	311	887	2.86
Total[1] or average	8,543	18,316	2.14	10,944	25,417	2.32	9,990	23,612	2.36

NA Not available.

[1] Data may not add to totals shown because of independent rounding.

Table 5.—Connecticut: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	3,992	$8,508	$2.13	5,458	$12,556	$2.30	5,058	$11,780	$2.33
Gravel	4,550	9,808	2.16	5,486	12,861	2.34	4,932	11,832	2.40
Total or average	8,543	18,316	2.14	10,944	25,417	2.32	9,990	23,612	2.36
Industrial sand	W	W	W	67	1,140	17.10	W	W	W
Grand total[1] or average	W	W	W	11,011	26,557	2.41	W	W	W

W Withheld to avoid disclosing company proprietary data.

[1] Data may not add to totals shown because of independent rounding.

Multiple land use and reclamation are considered integral parts of a company's mining plans. An abandoned sand and gravel quarry in Newtown was converted to recreational usage. The first phase of the reclamation-conversion resulted in the construction of three ball fields and parking areas.

Stone.—Stone was the leading mineral commodity in terms of value in Connecticut in 1979. Traprock was the major stone produced with respect to value and quantity. Connecticut ranked fifth in the United States in production. Traprock constituted an important export; it was barged to New York, New Jersey, and other Northeastern States, and was carried by rail as far as Illinois for use as railroad ballast.

Crushed granite and traprock were produced by 7 companies operating 11 quarries in Hartford, Litchfield, New Haven, and Tolland Counties. All of the State's crushed stone production was from open pit operations.

Crushed limestone and dolomite were produced by four operations in Litchfield County, in the northwestern part of the State, and by one operation in Fairfield County, in the southwestern part of the State. The quarry-run material was processed for marketing as aggregate, agricultural limestone, and for lime production.

Crushed quartz and sandstone were produced in Middlesex and New London Counties in the southeastern part of the State. Middlesex County quartz was a byproduct of processing pegmatitic material for feldspar; whereas, in New London County, quartz was mined from a replacement body at Lantern Hill. Uses for the quartz were in glass, terrazzo, asphalt, industrial fillers, abrasives, and flux.

Dimension granite was produced in Hartford, New Haven, New London, Tolland, and Windham Counties, in the central and eastern parts of the State. The granite was marketed as building stone veneer, rough blocks, rubble, flagging, curbing, and irregular stone. Dimension sandstone was produced in Windham County and sold for rough construction and rubble.

Table 6.—Connecticut: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Argicultural limestone	W	W	62	384	65	409
Concrete aggregate	[r]1,511	[r]4,059	1,538	3,952	1,216	5,621
Bituminous aggregate	2.054	5,568	2,166	5,684	2,322	12,152
Macadam aggregate	62	201	116	270	W	W
Dense-graded roadbase stone	523	1,536	534	1,551	1,599	6,641
Surface treatment aggregate	222	702	228	714	W	W
Other construction aggregate and roadstone	1,836	5,414	1,902	6,146	1,558	5,833
Riprap and jetty stone	38	102	W	W	175	814
Filter stone	43	130	W	W	W	W
Manufactured fine aggregate	--	--	W	W	20	99
Terrazzo and exposed aggregate	W	W	--	--	14	24
Cement manufacture	--	--	--	--	14	24
Lime manufacture	W	W	W	W	20	35
Whiting	--	--	W	W	94	1,207
Other filler and extenders	W	W	W	W	106	1,108
Other uses[2]	[r]692	[r]2,608	819	3,600	1,080	4,783
Total[3]	6,980	20,319	7,364	22,301	8,271	38,767

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, sandstone and traprock.

[2] Includes stone used for railroad ballast, flux stone, and stucco (1977).

[3] Data may not add to totals shown because of independent rounding.

METALS

Although there was no metal mining in Connecticut, the fabrication of ferrous and nonferrous products and the manufacture of calcium metal added significantly to the State's economy. Six steel fabrication mills produced bars, rods, strips, and wire rope. One firm in Hartford County produced steel shot and grit. Ferrous and nonferrous castings were produced at approximately 75 foundries, and ferrous and nonferrous forging and ingots were produced at 11 foundries. Ferrous scrap was collected and processed by approximately 25 scrap metal dealers; scrap was sold to area foundries and exported to other States for recycling.

Century Brass Products, Inc., of Waterbury, continued to expand its operations with the acquisition of Clark Brass and Copper Co. of Chicago, Wiltshire Industry, Inc., of Waterbury, and Burlington Brass Works in Wisconsin. Century, with 2,500 employees, is the largest employer in Waterbury. In an agreement between labor and management reached during contract negotiations, Bridgeport Brass Co. of Connecticut reduced its labor force from over 700 to about 500 workers for economic reasons. Hamden Steel and Aluminum, Inc., the recipient of a $1.95 million tax-exempt bond grant by the Connecticut Development Authority, increased employment and production.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
The Michael Kane Brick Co	654 Newfield St. Middletown, CT 06475	Pit and mill	Middlesex.
Kelsey-Ferguson Brick Co. (Div. of Susquehanna Corp.)	Route 5 East Windsor Hill, CT 06028	Mine and mill	Hartford.
Feldspar: The Feldspar Corp.[1]	Box 99 Spruce Pine, NC 28777	Mines and plant	Middlesex.
Lime: Pfizer, Inc.[2]	Daisy Hill Rd. Canaan, CT 06018	Pit and limekiln	Litchfield.
Sand and gravel:			
Dunning Sand and Gravel Co., Inc	Brickyard Rd. Farmington, CT 06037	Pit	Hartford.
Finco Corp	Pent Highway Wallingford, CT 06492	Pit	New Haven.
Leverty and Hurley Co	260 Bostwick Ave. Bridgeport, CT 06605	Pit	Do.
Loma Sand and Gravel Co	Box 277 Newtown, CT 06470	Pit	Fairfield.
Roncari Industries, Inc.[3]	1776 South Main St. East Granby, CT 06026	Pit	Hartford.
Sega Sand and Gravel Co. Inc	271 Danbury Ave. New Millford, CT 06776	Pit	Litchfield.
Silliman Co	290 North Ave. Bridgeport, CT 06601	Pit	New Haven.
South Windham Sand and Gravel	Box 100 South Windham, CT 06280	Pit	Windham.
Windham Send and Stone, Inc	Box 346 Willimantic, CT 06226	Pit	Do.
Silica, ground and crushed:			
Ottawa Silica Co	Box 577 Ottawa, IL 61350	Pit and plant	New London.
Stone, basalt (crushed and broken):			
The Balf Co.[4]	Box 11190 Newington, CT 06111	Quarry	Hartford.
New Haven Traprock Co. (Div. of Ashland Oil, Inc.)[5]	Box 5033 Hamden, CT 06518	Quarries	Hartford and New Haven.
Oneglia and Gervasini Building Materials.	Casson Ave. Torrington, CT 06790	Quarry	Litchfield.
York Hill Trap Rock Quarry Co.	Westfield Rd. Meriden, CT 06450	do	New Haven.

[1] Also crude mica, and ground and crushed silica.
[2] Also limestone and dolomite.
[3] Also basalt.
[4] Also sand and gravel.
[5] Also crushed granite.

The Mineral Industry of Delaware

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Delaware Geological Survey for collecting information on all nonfuel minerals.

By William Kebblish[1]

The value of nonfuel mineral production in Delaware was $2.5 million in 1978 and $3.3 million in 1979. Sand and gravel continued to be the most important commodity produced. Of lesser importance were clay and magnesium compounds, while sulfur and slag were recovered from processing of other commodities.

Trends and Developments.—The Delaware Economic Development Council, established in 1978, continued efforts in 1979 to attract new industry into the State. The Pigeon Creek plant, New Castle County, funded with Federal money, will recycle refuse and sludge. Glass and iron products will be recovered and combustible material used as fuel.

In 1979, the Delaware Geological Survey published a report entitled "Removal of Metals From Laboratory Solutions and Landfill Leachate by Greensand Filters." Greensands are useful for the removal of various metals from contaminated water and the removal of heavy metals from landfill leachate. Data on the near surface greensand deposits in the Middletown-Odessa area were collected by the Delaware Survey in cooperation with the Federal Bureau of Mines.

Employment.—Delaware's mining industry employed only a limited number of workers. In 1978, 48 persons were employed in sand and gravel operations, 16 in clay pits, and 13 at gypsum plants, for a State total of 77 workers.

Legislation and Government Programs.—Potential mineral-related development, including industrial support facili-

Table 1.—Nonfuel mineral production in Delaware[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ---- thousand short tons--	11	$7	10	$8	11	$9
Sand and gravel---------do----	1,351	2,084	1,449	2,468	1,674	3,281
Total ------------------	XX	[2]2,091	XX	[2]2,476	XX	[2]3,290

XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Partial total; excludes the value of gem stones and magnesium compounds, which must be concealed to avoid disclosing company proprietary data.

Table 2.—Indicators of Delaware business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	270.0	273.0	275.0	+0.7
Unemployment do	23.0	21.0	22.0	+4.8
Employment (nonagricultural):				
Mining do	(¹)	(¹)	(¹)	--
Manufacturing do	67.6	69.0	70.0	+1.4
Contract construction do	14.3	15.0	15.4	+2.7
Transportation and public utilities do	12.1	12.7	12.6	-0.8
Wholesale and retail trade do	53.1	54.7	56.1	+2.6
Finance, insurance, real estate do	10.9	11.2	11.7	+4.5
Services do	[2]39.6	[2]42.6	45.8	+7.5
Government do	41.4	42.8	44.5	+4.0
Total nonagricultural employment do	238.8	[3]247.8	[3]256.3	+3.4
Personal income:				
Total millions	$4,449	$4,970	$5,550	+11.7
Per capita	$7,643	$8,531	$9,587	+11.8
Construction activity:				
Number of private and public residential units authorized	3,414	3,033	2,985	-1.6
Value of nonresidential construction millions	$50.8	$42.3	$52.3	+23.6
Value of State road contract awards do	$19.8	$22.0	$26.0	+18.2
Shipments of portland and masonry cement to and within the State thousand short tons	157	149	163	+9.4
Nonfuel mineral production value:				
Total crude mineral value millions	$2.1	$2.5	$3.3	+32.0
Value per capita, resident population	$4	$4	$6	+50.0
Value per square mile	$1,017	$1,204	$1,599	+32.8

[p] Preliminary.
[1] Included with "Services."
[2] Includes mining.
[3] Data may not add to totals shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

ties, are subject to the State's Coastal Zone Program. The program affords a systematic approach to decisionmaking regarding the use of Delaware's coastal lands and waters, providing for reasonable growth and development while conserving and protecting irreplaceable resources. In 1979, Governor du Pont signed into law a bill permitting construction of onshore oil drilling support facilities in the State's coastal zone.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Clays.—Delaware Brick Co., located in New Castle County, was the only producer of clay in the State. Production was slightly over 10,000 short tons in 1978, increasing approximately 10% in 1979. Common clay and shale was mined at one pit and the raw product used in the manufacture of common and face brick.

Gypsum.—Crude gypsum, imported from Nova Scotia, was calcined by Georgia-Pacific Corp., Wilmington, New Castle County, for use in wallboard manufacturing. Production of calcined gypsum increased to meet the growing needs of the housing industry.

Magnesium Compounds.—The Barcroft Co. plant at Lewes, Sussex County, continued to produce magnesium hydroxide (milk of magnesia) from seawater.

Sand and Gravel.—Production of sand and gravel totaled less than 2 million short tons in 1979 and was valued in excess of $3 million. This was a slight increase in both quantity and value over that of 1978.

Construction sand and gravel was produced by nine companies in 1979 in two of the State's three counties. Leading producers in New Castle County were Parkway Gravel, Inc., and Contractor Sand & Gravel Co. Producers in Kent County were Dover Equipment & Machine Co., Staytons Select Borrew, and Porter Sand & Gravel Co. Sussex County, located in the southern part of the State, had no production.

In 1978-79, three-fourths of the production was processed sand and the remaining one-fourth was processed gravel, with an average unit value of $1.70 in 1978 and $1.96 in 1979. Sand and gravel was used mainly for roadbase and concrete aggregate. Secondary uses included fill, various concrete products, and snow and ice control. Over 91% of the sand and gravel was transported to market by truck; the remaining 9% was used locally. There was no production of industrial sand and gravel.

Table 3.—Delaware: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	205	$483	$2.36	278	$746	$2.69	428	$1,087	$2.54
Plaster and gunite sands	NA	NA	NA	W	W	W	W	W	W
Concrete products	78	191	2.46	W	W	W	W	W	W
Asphaltic concrete	108	211	1.96	W	W	W	W	W	W
Roadbase and coverings	803	1,039	1.29	811	1,070	1.32	870	1,519	1.75
Fill	158	160	1.01	W	W	W	W	W	W
Snow and ice control	NA	NA	NA	W	W	W	W	W	W
Total[1] or average	1,351	2,084	1.54	1,449	2,468	1.70	1,674	3,281	1.96

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Table 4.—Delaware: Construction sand and gravel sold or used by producers

	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	926	$1,375	$1.49	1,107	$1,859	$1.68	546	$1,265	$2.31
Gravel	425	709	1.67	342	609	1.78	1,127	2,017	1.79
Total[1] or average	1,351	2,084	1.54	1,449	2,468	1.70	1,674	3,281	1.96

[1] Data may not add to totals shown because of independent rounding.

Table 5.—Delaware: Construction sand and gravel sold or used, by county

(Thousand short tons and thousand dollars)

County	1977			1978			1979		
	Quantity	Value	Number of companies	Quantity	Value	Number of companies	Quantity	Value	Number of companies
Kent	516	900	6	588	1,087	7	700	1,492	6
New Castle	835	1,184	3	861	1,381	3	973	1,789	3
Total[1]	1,351	2,084	9	1,449	2,468	10	1,674	3,281	9

[1] Data may not add to totals shown because of independent rounding.

Slag.—International Mill Service Co. sold steel slag, a byproduct of the steelmaking process. Delaware's steel center is located in Dover. Slag was used primarily for roadbase.

Sulfur.—Elemental sulfur was recovered at Getty Refining & Marketing Co.'s Delaware City plant, New Castle County, as a byproduct of petroleum refining. High-sulfur coke produced at the refinery will be used for power generation purposes at a nearby Delmarva Power & Light Co. plant. For the powerplant to use the coke and meet air quality standards, Getty Refining plans to install a stack gas scrubber and a sulfuric acid plant at the Delmarva plant site.

METALS

Iron and Steel.—The Phoenix Steel Corp., Dover, Kent County, produced carbon, alloy, and clad plate. Early in 1979, Federal loan guarantees totaling $68 million were available for modernization programs to insure a marketable product and to guarantee employment for the 1,200 workers. Three years ago, Phoenix Steel Corp. was acquired by Creusot Loire, a French steel manufacturer.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Clays: Delaware Brick Co	River Rd. New Castle, DE 19720	Pit	New Castle.
Gypsum, calcined:			
Georgia-Pacific Corp	900 SW. 5th Ave. Portland, OR 97204	Plant	Do.
Magnesium compounds:			
Barcroft Co	Box 474, Henlopen Dr. Lewes, DE 19958	do	Sussex.
Sand and gravel:			
Barber Sand and Gravel	R.F.D. 1 Harrington, DE 19952	2 dredges	Kent.
Contractor Sand & Gravel Co	Box 2630 Wilmington, DE 19805	2 pits	New Castle.
Dover Equipment & Machine Co	113 West 6th St. Dover, DE 19901	2 dredges	Kent.
George Nashold, Inc	Box 286 Frederica, DE 19946	3 dredges	Do.
Parkway Gravel, Inc	4048 New Castle Ave. New Castle, DE 19720	4 pits	New Castle.
Porter Sand & Gravel Co	Harrington, DE 19952	Pit	Kent.
Staytons Select Borrew	R.D. 1, Box 305 Felton, DE 19943	Pit	Do.
Warren Bros	Box 858 Dover, DE 19901	2 dredges	Do.
Whittington Sand & Gravel Co	U.S. Route 40 Bear, DE 19701	Pit	New Castle.
Slag:			
International Mill Service Co	1500 Walnut St. Philadelphia, PA 19102	Plant	Kent.
Sulfur, elemental:			
Getty Refining & Marketing Co	Delaware City, DE 19706	Refinery	New Castle.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

The Mineral Industry of Florida

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Florida Bureau of Geology for collecting information on all nonfuel minerals.

By James R. Boyle[1] and Charles W. Hendry, Jr.[2]

The value of nonfuel mineral production in Florida in 1978 and 1979 was $1.1 billion and $1.3 billion, respectively. The State ranked first in the production of phosphate rock and titanium concentrates, and second in fuller's earth and peat. Staurolite and zircon concentrates were produced only in Florida. Nonmetals accounted for nearly all of the State's total mineral production value in 1978 and 1979. The principal nonmetals produced, in order of value, were phosphate rock, stone, cement, sand and gravel, and clays. All commodities, with the exception of magnesium compounds, staurolite, and zircon concentrates, registered an increase in production and value. Except for titanium concentrates and zircon concentrates, all commodities registered an increase in unit value.

Table 1.—Nonfuel mineral production in Florida[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:						
Masonry thousand short tons	W	W	W	W	255	$13,098
Portland do	2,540	$87,561	2,766	$111,892	2,957	126,562
Clays do	581	[2]22,313	601	28,850	681	[2]31,308
Gem stones	--	--	NA	5	NA	4
Lime thousand short tons	165	7,350	180	8,182	210	11,440
Peat do	125	1,396	158	2,246	153	2,190
Sand and gravel do	20,218	38,989	21,860	36,950	21,708	39,520
Stone (crushed) do	48,558	101,435	57,354	128,905	W	W
Combined value of clays (kaolin, 1977 and 1979), magnesium compounds, phosphate rock, rare-earth concentrate, staurolite, stone (dimension, 1977), titanium concentrate (ilmenite and rutile), and zircon concentrate, and values indicated by symbol W	XX	702,832	XX	781,742	XX	1,045,549
Total	XX	961,876	XX	1,098,772	XX	1,269,671

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes value of kaolin; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Florida, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Alachua	$2,278	$3,074	Stone.
Bay	509	663	Sand and gravel.
Brevard	2,600	W	Clays, sand and gravel, stone.
Broward	10,728	12,408	Stone, sand and gravel.
Calhoun	15	75	Sand and gravel.
Charlotte	W	W	Stone, sand and gravel.
Citrus	2,172	2,445	Stone, phosphate rock.
Clay	24,378	23,838	Ilmenite, zircon, rutile, staurolite, sand and gravel, monazite, clays.
Collier	2,877	3,521	Stone.
Dade	W	W	Cement, stone, sand and gravel.
Dixie	W	W	Stone.
Escambia	466	680	Sand and gravel.
Gadsden	W	W	Clays, sand and gravel.
Glades	W	W	Sand and gravel.
Gulf	W	W	Magnesium compounds, lime.
Hamilton	W	W	Phosphate rock.
Hardee	--	W	Do.
Hendry	W	W	Sand and gravel, stone.
Hernando	W	W	Stone, cement, lime, clays.
Highlands	678	W	Peat.
Hillsborough	W	W	Phosphate rock, cement, stone, peat.
Jackson	520	1,594	Stone, sand and gravel.
Lake	4,560	W	Sand and gravel, peat.
Lee	5,435	8,036	Stone.
Leon	W	W	Sand and gravel.
Levy	1,905	449	Stone.
Manatee	W	W	Cement.
Marion	8,204	10,189	Stone, clays, sand and gravel, phosphate rock.
Monroe	333	W	Stone.
Nassau	W	W	Titanium, zircon, monazite.
Okaloosa	24	33	Sand and gravel.
Orange	--	64	Do.
Osceola	16	--	
Palm Beach	W	90	Stone.
Pasco	1,358	W	Do.
Polk	W	640,981	Phosphate rock, sand and gravel, peat.
Putnam	W	W	Sand and gravel, clays, peat.
St. Lucie	W	307	Sand and gravel.
Santa Rosa	W	W	Do.
Sarasota	W	W	Sand and gravel, stone.
Sumter	W	W	Stone, lime.
Suwannee	W	W	Stone.
Taylor	W	W	Do.
Wakulla	W	--	
Walton	W	W	Sand and gravel.
Undistributed[2]	892,828	390,321	
Total[3]	961,876	1,098,772	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] The following counties are not listed because no nonfuel mineral production was reported: Baker, Bradford, Columbia, De Soto, Duval, Flagler, Franklin, Gilchrist, Holmes, Indian River, Jefferson, Lafayette, Liberty, Madison, Martin, Okeechobee, Pinellas, St. Johns, Seminole, Union, Volusia, and Washington.

[2] Includes gem stones and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Of the 50.0 million metric tons of phosphate rock produced in the United States, Florida was the predominant producer, and for the 85th and 86th consecutive years supplied more than any other State. Florida and North Carolina supplied over 85% of the domestic phosphate rock output, and Florida supplied most of the exports.

Trends and Developments.—Of the 15 ports in Florida, 12 are served by oceangoing vessels and 3 by barges.

The Port of Tampa, the seventh largest port in the Nation in terms of total tonnage, recorded a 65% increase in tonnage since 1967. In 1978, approximately 50% of the total tonnage was represented by phosphate and related products. Tampa imports substantial quantities of mineral raw materials used in fertilizer manufacture plus coal and coke. Of the total imports, 26% were mineral or related commodities. The leading export was raw phosphate rock which, along with fertilizers, accounted for 93% of total exports. There are 16 terminals located in the Tampa area to handle phosphate fertilizer and related chemicals.

The first shipment of Soviet anhydrous ammonia was made under a 20-year, $20

Table 3.—Indicators of Florida business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	3,519.0	3,711.0	3,835.0	+3.3
Unemployment do	289.0	246.0	230.0	-6.5
Employment (nonagricultural):				
Mining[1] do	9.1	9.5	10.0	+5.3
Manufacturing do	380.9	415.5	437.7	+5.3
Contract construction do	178.9	209.5	244.8	+16.8
Transportation and public utilities do	185.1	194.2	209.7	+8.0
Wholesale and retail trade do	771.0	836.9	897.4	+7.2
Finance, insurance, real estate do	202.5	219.3	232.7	+6.1
Services do	640.0	693.9	742.8	+7.0
Government do	565.7	601.8	604.5	+0.4
Total nonagricultural employment[1] do	2,933.2	3,180.6	3,379.7	+6.3
Personal income:				
Total millions	$56,961	$65,130	$75,597	+16.1
Per capita	$6,728	$7,578	$8,532	+12.6
Construction activity:				
Number of private and public residential units authorized	108,052	[2]163,862	177,561	+8.4
Value of nonresidential construction millions	$1,070.0	$1,403.4	$1,684.8	+20.1
Value of State road contract awards do	$280.0	NA	$383.6	
Shipments of portland and masonry cement to and within the State thousand short tons	4,114	4,620	4,998	+8.2
Nonfuel mineral production value:				
Total crude mineral value millions	$961.9	$1,098.8	$1,269.7	+15.6
Value per capita, resident population	$114	$128	$143	+11.7
Value per square mile	$16,425	$18,763	$21,682	+15.6

[p] Preliminary. NA Not available.

[1] Includes oil and gas extraction.

[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

billion trade pact between the U.S.S.R. and Occidental Petroleum Corp. (Oxy). The trade agreement calls for Oxy to supply 1 million tons of super phosphoric acid annually from its White Springs operation. In return, Oxy will receive ammonia, urea, and potash.

Legislation and Government Programs.—Under contract to the Environmental Protection Agency (EPA), Texas Instruments, Inc., prepared a draft Environmental Impact Statement (EIS) intended to establish guidelines for the issuance of Federal environmental permits for new phosphate mines and mills in a seven-county area. The final EIS, released in March 1978, recommended the elimination of rock drying and of slime ponds; improved recirculation of water; radiation standards; reclamation requirements; protection of wetlands; protection of ground water systems; fluorine emission standards; and recovery of uranium.

Since 1972, the Federal Bureau of Mines (Bureau), at its Tuscaloosa Research Center, has been involved in a concerted research effort to develop methods that will either eliminate the waste slimes retention areas or provide an improved waste storage system.

In-house Bureau project activity during 1978 included research on water recovery from phosphatic clay slimes; continuous flocculation dewatering and floc formation studies; and reuse and purification of low-quality waters for processing.

Further research included beneficiation of dolomitic phosphate ores, beneficiation of phosphate-bearing Hawthorn Formation limestone, recovery of phosphate from beneficiation slimes, and direct acidulation of phosphate matrix to improve recovery of P_2O_5.

Zellars-Williams, Inc., under contract to the Bureau, evaluated phosphate deposits of Florida for the Minerals Availability System. In addition to deposit characterization by district, the report covers mining and beneficiation, cost estimation, regulatory and environmental considerations, identified resources, and production capacity.

The Bureau and the Florida Bureau of Geology participated in a cooperative effort to evaluate deep phosphate occurrences

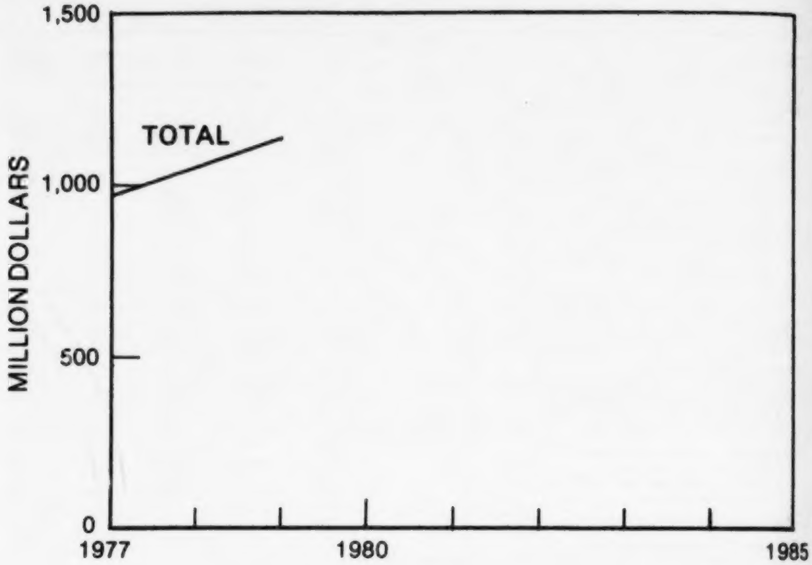

Figure 1.—Total value of nonfuel mineral production in Florida.

along Florida's east coast so that input could be made into the ongoing evaluation of the phosphate deposits of Florida. The objectives were to identify the occurrences of phosphate rock with their associated economic, physical, and environmental characteristics.

Florida's second largest phosphate producer, Agrico Chemical Co., planned an experimental mining project in St. Johns County with a grant from the Bureau. The mining technique involves drilling a well to the phosphate clay where a mining head dissolves the material and pumps it to the surface. Concern centers on whether the mining would harm the aquifer and lower water levels in the area.

The 1978 Florida Legislature extensively amended Chapter 211, Part II, Florida Statutes in response to the recommendations of the Phosphate Land Reclamation Study Commission. The basic change enacted was a redistribution of the severance tax.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Shipments of both portland and masonry cement increased in 1978 and again in 1979. Production of portland cement in the State ranked eighth nationally, while masonry ranked seventh. Five companies produced portland cement; two, masonry. Most of the shipments of both portland and masonry cements were within the State.

Portland cement shipments, mainly in bulk form, were made by truck and rail. Principal consumers were ready-mix companies, building materials dealers, concrete products manufacturers, with the remaining to other contractors and government agencies.

Principal raw materials used to manufacture cement were mined within the State and included limestone, clay, sand, and staurolite. Oolitic aragonite imported from the Bahamas was used by two companies. Small amounts of gypsum, clinker, fly ash, clay, iron ore, and slag were used, but most were obtained from out-of-State sources.

Eleven rotary kilns were operated at five plants. Of the 11, 10 were wet process and 1 was dry process. Nearly 400 million kilowatt-hours of electrical energy, in addition to natural gas and minor amounts of fuel oil and coal, were consumed in the manufacture of cement. All of the power was purchased.

Maule Industries, a Miami based integrated materials supplier that has been operating under bankruptcy status since 1976, was taken over by Lone Star Industries under a court order.

Clays.—Total clay production and value increased in 1978 and 1979. Florida ranked second in the Nation in fuller's earth production. Production increased from four producers, with nine pits in Brevard, Gadsden, and Marion Counties. Main end uses were for fertilizer fillers, pet waste adsorbents, pesticides, and drilling mud.

Kaolin was produced by one company at two pits in Putnam County. Principal uses were in electrical porcelain, whiteware, and wall tile.

Common clay output and value decreased in 1978, but increased in 1979. Miscellaneous clay was produced by two companies at two pits in Clay and Hernando Counties. The clays were used in the manufacture of cement and lightweight aggregate.

Fluorine.—Fluorine in the form of fluosilicic acid was recovered at six plants as a byproduct of wet-process phosphoric acid manufacture. Fluosilicic acid was used to produce cryolite, aluminum fluoride, sodium silica fluoride, and in water fluoridation. The value of fluorine byproducts is not included in the State's mineral value.

Gypsum.—Imported gypsum was calcined at two plants in Duval County and one plant in Hillsborough County. U.S. Gypsum Co., Jim Walter Corp., and National Gypsum Co. calcined gypsum in kettles, a rotary kiln, and a holoflite unit, respectively. A total of 626,000 short tons of calcined gypsum was produced in 1978; production in 1979 increased to 659,000 tons.

Lime.—Quicklime was produced by Basic Magnesia, Inc., Gulf County; Chemical Lime, Inc., Hernando County; and Dixie Lime & Stone Co., Sumter County. Hydrated lime was produced by Chemical Lime, Inc. Lime was used for magnesia recovery, water treatment, and in sewage disposal.

Magnesia.—Basic Magnesia, Inc., Port St. Joe, Gulf County, produced caustic calcined magnesia and refractory-grade magnesia from seawater. Shipments and value in 1978 decreased 8.7% and 0.2%, respectively. Florida ranked third nationally in the recovery of magnesium compounds from seawater.

Peat.—Florida ranked second in peat production in 1978 and 1979. Nine plants produced moss, reed-sedge and humus peat from six counties. Most of the peat, shipped in bulk, was used to pack plants and shrubs, for general soil improvement, and for potting soils.

Perlite.—Four companies produced expanded perlite from crude ore shipped into the State. Production increased to 28,000 tons in 1978, and to 29,000 tons in 1979. Value increased to $2.8 million in 1978, and to $3.0 million in 1979. Production from plants in Broward, Duval, Escambia, and Indian River Counties was used for horticultural purposes, insulation, and fillers. The value of expanded perlite is not included in the State's mineral value.

Phosphate Rock.—Florida ranked first in the Nation in the production of phosphate rock. Marketable production of phosphate rock in 1978 increased 4.8% in quantity and 11.7% in value; 1979 production decreased 4.6% from that of 1978, but value increased 14.1%.

Soft-rock phosphate was produced by four companies in 1978 and 1979, operating six mines in Citrus and Marion Counties. The soft-rock phosphate was used for direct application to the soil.

Land-pebble phosphate was produced at 22 mines by 13 companies in Hamilton, Hardee, Hillsborough, and Polk Counties. In 1978, agricultural uses accounted for 69.0%, industrial 0.7%, and exports 30.3%; with similar distribution in 1979. Normal superphosphate, triple superphosphate, wet-process phosphoric acid, and defluorinated phosphate rock were produced for agricultural uses. Industrial uses included the manufacture of elemental phosphorus and ferrophosphorus.

The economic impact on the State of the phosphate industry reached $2.5 billion in 1979. The industry had a significant impact on central Florida, primarily Columbia, Hamilton, Hardee, Hillsborough, Manatee, and Polk Counties. Employment by the industry increased 12% in 1979, to 13,400. During 1979, an estimated $377 million was expended for expansion, replacement, and new construction, a 90% increase over 1978 expenditures.

Agrico Chemical Co.'s $20 million expansion project at its South Pierce acid facility will increase capacity to 420,000 tons per year. Completion date is scheduled for mid-1981. The company began negotiations with the Tampa Port Authority to sell its 225-acre loading terminal at Big Bend to the Authority for its expansion needs.

AMAX Inc., planned a $200 million, 4-million-ton-per-year mine in Manatee and De Soto Counties on land leased from Phillips Petroleum Co. At year's end, negotiations continued with Noranda Phosphate, Inc., for leasing of additional adjacent lands.

Beker Industries Corp. completed permitting requirements for a proposed 3-million-ton-per-year mine in Manatee County. The $80 to $100 million project is expected to go onstream in 1981; reserves are estimated to be 80 million tons.

Borden, Inc., completed their new beneficiation plant at the Big Four Mine in Hillsborough County. The facility includes systems to recycle water and scrubbers to reduce air pollution.

C. F. Industries became the first farm cooperative to mine phosphate when its new mine in Hardee County started operation in 1978. Production is planned at 1.5 to 2.0 million tons from the mine, with estimated reserves of 80 million tons.

Estech General Chemical Corp., formerly Swift Chemical Co., planned to develop a 3-million-ton-per-year mine in Manatee County by 1983. Two Japanese firms have a reported 12% interest, and Royster Co., a 20% interest in the operation.

Farmland Industries, Inc., planned to develop a 2-million-ton-per-year facility in Hardee County by 1981-82. The complex is expected to produce 2,400 tons of sulfuric acid per day, 300,000 tons per year of phosphoric acid, and 600,000 tons per year of diammonia phosphate.

Florida Phosphate Corp., a subsidiary of Great Lakes Carbon Corp., went onstream with its 100,000-ton-per-year phosphate recovery operation. The plant, north of Mulberry, will recover phosphate from debris mined earlier.

W. R. Grace & Co. and International Minerals & Chemical Corp. are jointly developing a 3- to 4-million-ton-per-year facility at Grace's Four Corner Mine in Hillsborough, Manatee, and Polk Counties. Development is scheduled for completion in 1982. W. R. Grace & Co. was awarded mining rights on 120 acres of Federal land in Polk County. The company is active in adjacent lands and owns the surface rights in the area.

International Minerals & Chemical Corp. (IMC) planned a $400 million expansion of its phosphate rock and chemical production. Included are a 2- to 3-million-ton-per-year expansion of phosphate mining and a 50% increase in chemical production at its Mulberry facility. IMC is converting its New Wales chemical plant to wet grinding and expects to save up to 8 million gallons of fuel oil and 18 million kilowatt-hours of electricity per year. Completion is expected in 1980. IMC also planned a $2.5 million expansion of its Port Sutton terminal on Tampa Bay. Capacity will be increased by 300,000 tons per year.

Mississippi Chemical Corp. continued the permit process to develop a 3-million-ton-per-year mine by the early 1980's. Reserves are estimated at 95 million tons in Hardee County. The company presently receives its phosphate rock primarily from Mobil Oil Corp.

Mobil Oil Corp. planned to develop a new mine in Hardee County to replace its 3-million-ton-per-year Forte Meade Mine, which is approaching exhaustion. Plans are to have the mine in operation by the mid-1980's.

Occidental Petroleum Corp. (Oxy) initiated a $140 million expansion of its chemical facilities adjacent to the Swift Creek Mine. Increased output of phosphoric acid will be required to meet the commitment Oxy has with the U.S.S.R. Oxy also has an agreement with Poland to supply 1 million tons per year of phosphate rock for 20 years. Oxy will purchase 500,000 tons of molten sulfur from Poland over the same period.

Sand and Gravel.—Sand and gravel output increased in 1978, but decreased in 1979. Lake, Polk, and Sarasota Counties were the leading producing counties, accounting for about 60% of the output. Lake, Polk, and Sarasota Counties also accounted for 56% of the value of production.

During 1979, 41 companies operated 54 mines in 21 counties. Transportation was primarily by truck, with the balance shipped by railroad, waterway, and other. The sand and gravel was used mainly for construction purposes, which include con-

Table 4.—Florida: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	12,344	$22,260	$1.80	11,452	$17,665	$1.54	11,949	$19,200	$1.61
Plaster and gunite sands	NA	NA	NA	W	W	W	239	584	2.44
Concrete products	1,922	4,010	2.09	1,633	3,197	1.96	869	1,765	2.03
Asphaltic concrete	467	1,256	2.69	515	1,420	2.76	868	2,195	2.53
Roadbase and coverings	2,350	3,873	1.65	1,128	1,439	1.28	2,214	2,845	1.28
Fill	1,836	1,903	1.04	5,703	6,175	1.08	4,503	4,556	1.01
Snow and ice control	NA	NA	NA	--	--	--	--	--	--
Other uses	301	515	1.71	296	824	2.78	--	--	--
Total[1] or average	19,220	33,816	1.76	20,730	30,720	1.48	20,642	31,145	1.51

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Data may not add to totals shown because of independent rounding.

Table 5.—Florida: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	16,869	$29,024	$1.72	19,894	$28,350	$1.43	18,143	$26,843	$1.48
Gravel	2,352	4,793	2.04	833	2,370	2.85	2,500	4,302	1.72
Total[1] or average	19,220	33,816	1.76	20,730	30,720	1.48	20,642	31,145	1.51
Industrial sand	997	5,172	5.19	1,128	6,226	5.52	1,066	8,375	7.86
Grand total[1] or average	20,218	38,989	1.93	21,860	36,950	1.69	21,708	39,520	1.82

[1] Data may not add to totals shown because of independent rounding.

Table 6.—Florida: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979[2]	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	1,019	3,529	1,000	3,695	1,131	6,036
Agricultural marl and other soil conditioners	W	W	W	W	52	452
Poultry grit and mineral food	W	W	W	W	490	2,837
Concrete aggregate	[r]12,889	[r]33,383	14,246	40,764	14,085	53,980
Bituminous aggregate	4,440	10,190	4,188	11,066	3,498	12,490
Macadam aggregate	578	1,519	721	2,514	W	W
Densegraded roadbase stone	15,409	23,164	18,047	30,341	17,603	37,602
Surface treatment aggregate	2,106	6,101	2,828	8 260	2,885	12,804
Other construction aggregate and roadstone	3,085	7,409	5,645	10,251	13,409	30,858
Riprap and jetty stone	61	291	51	265	58	277
Filter stone	44	W	79	W	55	233
Manufactured fine aggregate (stone sand)	3,093	6,600	4,029	9,376	5,642	19,770
Cement manufacture	2,554	3,173	2,731	3,455	2,344	5,139
Lime manufacture	W	W	W	W	367	1,007
Asphalt filler	--	--	W	W	21	209
Other fillers	W	W	W	W	188	1,222
Fill	2,342	2,722	2,606	3,597	1,580	2,919
Other uses[3]	937	3,357	1,184	5,321	200	632
Total[4]	48,558	101,435	57,354	128,905	63,609	188,467

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] 1977-78 data include limestone, shell, and marl.

[2] Crushed limestone only.

[3] Includes stone used for railroad and glass manufacture, unspecified uses, and uses indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

crete aggregate and fill, with the balance going into industrial uses.

Staurolite.—Staurolite was recovered as a byproduct of ilmenite production at the Highland and Trail Ridge plants of E. I. du Pont de Nemours & Co., Clay County. Production decreased in 1978, but increased substantially in 1979. Staurolite was mainly used in sandblasting, and minor amounts, in cement. Florida is the only State with a record production of staurolite.

Stone.—Florida ranked third in the Nation in crushed stone production, which included crushed limestone, dolomite, and oyster shell.

Stone was produced by 75 companies at 105 quarries in 21 counties. The three leading producing counties were Broward, Dade, and Hernando, which supplied nearly 70% of the State's total tonnage and value. Fifteen companies produced over 1 million tons each from 33 quarries, and accounted for 71% of the production and 75% of the value.

Crushed stone was transported mainly by truck, followed by railroad, and other. Crushed stone was used for dense-graded roadbase, concrete and bituminous aggregate, and for cement manufacture. Two companies processed oyster shell for roadbed material.

Sulfur.—Florida ranked fifth in the Nation in the recovery of sulfur from petroleum. Recovered sulfur from Exxon's desulfurization plants in Santa Rosa County increased slightly in 1978, but decreased in 1979. The value of byproduct sulfur is not included in the State's mineral production value.

Vermiculite.—Exfoliated vermiculite was produced by two operators at four plants in Broward, Duval, and Hillsborough Counties from crude ore shipped into the State. Main uses were for lightweight concrete aggregate, horticulture, and insulation. The value is not included in the State's mineral value.

METALS

Rare-Earth Minerals.—Humphrey's Mining Co., Nassau County, and Titanium Enterprises, Clay County, produced monazite concentrate as a coproduct from their heavy minerals operation. The dredging and wet milling portions of the Titanium Enterprise's heavy mineral sand operation at Green Cove Springs were shut down in mid-1978 because of economic conditions, mainly the depressed price for zircon. Production of zircon, staurolite, and monazite continued from the company's dry mill tailings. Tailings are sufficient for another 2 years production at current rates. At yearend, the operation was for sale. Although the zircon price was low, the demand for monazite was firm.

Titanium.—Titanium Enterprises and E. I. du Pont de Nemours & Co., Clay County, and Humphrey's Mining Co., Nassau County, produced titanium concentrate. Humphrey's Mining Co.'s operation closed in 1979 owing to depleted reserves.

Zircon Concentrate.—Production and value of zircon concentrates from E. I. du Pont de Nemours & Co. and Titanium Enterprises, both in Clay County, decreased in 1978. Florida was the only producer of zircon concentrate.

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[1] State mineral specialist, Bureau of Mines, Tuscaloosa, Ala.

[2] State geologist, Florida Bureau of Geology, Tallahassee, Fla.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Florida Mining & Materials Corp	Box 23965 Tampa, FL 33622	Plant	Hernando.
General Portland, Inc	4400 Republic National Bank Tower, Box 324 Dallas, TX 75221	Plants	Dade and Hillsborough.
Lone Star Florida, Inc	Box 2035 PVS Hialeah, FL 33012	Plant	Dade.
Rinker Portland Cement Corp	Drawer K West Palm Beach, FL 33402	do	Do.
Clays:			
Engelhard Minerals & Chemicals Corp.	Menlo Park Edison, NJ 08817	Open pit mines	Gadsden.
Mid-Florida Mining	Box 68-F Lowell, FL 32663	do	Marion.
Pennsylvania Glass Sand Corp	Berkeley Springs, WV 35411	do	Gadsden.
Gypsum (calcined):			
Jim Walter Corp	Box 135 Jacksonville, FL 32226	Plant	Duval.
National Gypsum Co	4100 First Intl. Bldg. Dallas, TX 75270	do	Hillsborough.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Duval.
Lime:			
Chemical Lime, Inc	Box 250 Ocala, FL 32670	do	Hernando.
Dixie Lime & Stone Co.[1]	Drawer 217 Ocala, FL 32670	do	Sumter.
Magnesium compounds:			
Basic Magnesia, Inc.[2]	Box 160 Port St. Joe, FL 32456	do	Gulf.
Peat:			
F. E. Stearns Peat	Route 1, Box 542D Dover, FL 33527	Bog	Hillsborough.
Superior Peat & Soil	Box 2688 Sebring, FL 33870	Bog	Highlands.
Perlite (expanded):			
Airlite Processing Corp. of Florida.	Route 2, Box 740 Vero Beach, FL 32960	Plant	Indian River.
Armstrong Cork Co	Box 1991 Pensacola, FL 32589	do	Escambia.
Chemrock Corp	End of Osage Street Nashville, TN 37208	do	Duval.
W. R. Grace & Co.[3]	62 Whittemore Ave. Cambridge, MA 02140	do	Broward.
Phosphate rock:			
Agrico Chemical Co	Box 3166 Tulsa, OK 74101	Open pit mines andplants.	Polk.
Borden, Inc	Box 790 Plant City, FL 33566	Open pit mine and plant.	Hillsborough and Polk.
Brewster Phosphates	Bradley, FL 33835	do	Do.
C. F. Industries	Box 790 Plant City, FL 33566	do	Hardee.
Estech General Chemical Corp	Box 208 Bartow, FL 33830	Open pit mines	Polk.
Gardinier, Inc	Box 3269 Tampa, FL 33601	Open pit mine and plant.	Do.
International Minerals & Chemical Corp.	Box 867 Bartow, FL 38830	Open pit mines	Do.
Mobil Oil Corp.[4]	Box 311 Nichols, FL 33863	do	Do.
Occidental Petroleum Corp	White Springs, FL 32096	Open pit mine	Hamilton.
U.S.S. Agri-Chemicals, Inc	Box 867 Ft. Meade, FL 33841	do	Polk.
W. R. Grace & Co	Box 471 Bartow, FL 33830	Open pit mine and plant.	Do.
Sand and gravel:			
Florida Rock Industries, Inc., Shands & Baker.	744 Riverside Ave. Jacksonville, FL 32201	Pits	Clay, Dade, Glades, Lake.
General Development Corp	1111 South Bayshore Dr. Miami, FL 33131	do	Brevard, Charlotte, Sarasota, St. Lucie.
E. R. Jahna Industries, Inc., Ortona Sand Co. Div.	First & East Tillman Lake Wales, FL 33853	do	Glades, Lake, Polk.
Standard Sand & Silica Co	Box 35 Davenport, FL 33837	do	Dade, Polk, Marion, Lake.
Staurolite:			
E. I. du Pont de Nemours & Co	DuPont Bldg. D-10084 Wilmington, DE 19898	Mines and plants	Clay.

See footnotes at end of table.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone:			
Florida Crushed Stone Co	Box 317 Leesburg, FL 32748	Quarries	Hernando and Sumter.
Florida Rock Industries, Inc.[5]	Box 427 Brooksville, FL 33512	do	Collier, Lee, Sumter, Suwannee.
Lone Star Florida, Inc	Box 2601 PVS Hialeah, FL 33012	Quarry	Dade.
Southeastern Materials, Inc	Box 2634 Miami, FL 33012	Quarries	Do.
Vulcan Materials Co	Box 660097 Miami Springs, FL 33166	do	Broward and Dade.
Titanium concentrates:			
E. I. du Pont de Nemours & Co	DuPont Bldg. D-10084 Wilmington, DE 19898	Mines and plants	Clay.
Titanium Enterprises[6]	Green Cove Springs, FL 32043	Mine and plant	Do.

[1] Also stone.
[2] Also lime.
[3] Also phosphate rock and exfoliated vermiculite.
[4] Also elemental phosphorus.
[5] Also sand and gravel.
[6] Also zircon concentrate and rare-earth oxides and thorium oxide in monazite concentrate.

The Mineral Industry of Georgia

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Georgia Geologic Survey, Environmental Protection Division, Georgia Department of Natural Resources, for collecting information on all nonfuel minerals.

By James R. Boyle[1] and William H. McLemore[2]

The value of Georgia's nonfuel mineral production in 1978 and 1979 was $588.1 million and $698.7 million, respectively. Georgia led the Nation in the production of fuller's earth, kaolin, and dimension stone; was second in kyanite and iron oxide pigments; third in bauxite and feldspar; fourth in barite and byproduct gypsum; and fifth in common clays and mica. With the exception of bauxite, kyanite, and sand and gravel, all commodities registered an increase in unit value in 1978.

Table 1.—Nonfuel mineral production in Georgia[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:						
Portland thousand short tons	1,192	$37,711	1,435	$51,504	1,335	$55,117
Masonry do	W	W	W	W	102	5,172
Clays do	7,554	288,223	8,476	358,654	8,322	437,671
Gem stones	--	--	NA	20	NA	20
Sand and gravel thousand short tons	5,141	13,207	5,378	12,550	[2]5,014	[2]10,792
Stone:						
Crushed do	37,864	106,215	41,572	131,959	40,902	154,021
Dimension do	240	13,637	277	15,879	244	17,908
Talc short tons	23,540	63	W	W	W	W
Combined value of barite, bauxite, feldspar, iron ore (1977), kyanite, mica, peat, sand and gravel (industrial, 1979), and values indicated by symbol W	XX	15,307	XX	17,548	XX	17,989
Total	XX	474,363	XX	588,114	XX	698,690

NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Georgia, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Bacon	W	--	
Baldwin	W	W	Sand and gravel.
Barrow	W	W	Stone.
Bartow	W	W	Barite, clays.
Bibb	W	W	Clays, sand and gravel.
Carroll	W	W	Stone.
Chatham	$511	$536	Sand and gravel.
Cherokee	W	W	Do.
Clarke	W	2,194	Stone.
Clayton	W	3,675	Do.
Cobb	W	W	Stone, sand and gravel.
Coffee	W	W	Sand and gravel.
Columbia	W	W	Clays, stone.
Columbus (city)	W	W	Stone, sand and gravel, clays.
Cook	W	W	Sand and gravel.
Coweta	W	W	Stone.
Crawford	W	W	Sand and gravel.
Decatur	W	12,934	Clays, sand and gravel.
De Kalb	6,152	W	Stone.
Dougherty	272	W	Sand and gravel.
Douglas	W	W	Stone, clays, sand and gravel.
Effingham	W	W	Sand and gravel.
Elbert	W	W	Stone, sand and gravel.
Evans	W	132	Sand and gravel.
Fayette	1,554	2,070	Stone.
Floyd	W	W	Stone, clays.
Forsyth	W	2,623	Stone.
Fulton	W	W	Cement, stone, clays, sand and gravel.
Gilmer	W	W	Stone.
Glynn	W	72	Sand and gravel.
Gordon	1,250	1,663	Stone.
Greene	W	W	Sand and gravel, stone.
Gwinnett	W	W	Stone.
Habersham	W	W	Do.
Hall	W	W	Do.
Hart	W	W	Mica.
Henry	W	W	Stone.
Houston	W	W	Cement, clays, stone.
Jasper	W	W	Feldspar, stone.
Jefferson	W	W	Clays.
Jones	W	W	Stone.
Laurens	--	W	Sand and gravel.
Lee	W	W	Stone, sand and gravel.
Lincoln	W	W	Kyanite.
Long	--	320	Sand and gravel.
Lowndes	W	W	Do.
Lumpkin	W	W	Stone.
Madison	W	W	Do.
Marion	W	W	Sand and gravel.
Miller	3	6	Peat.
Monroe	W	W	Stone.
Montgomery	--	W	Sand and gravel.
Murray	W	W	Talc.
Oglethorpe	1,835	2,220	Stone.
Paulding	W	W	Do.
Pickens	13,756	15,927	Do.
Pierce	W	--	
Pike	210	W	Sand and gravel.
Polk	W	W	Cement, stone, clays.
Quitman	W	--	
Rabun	700	1,306	Stone.
Richmond	W	W	Clays, stone, sand and gravel.
Screven	W	W	Peat.
Seminole	W	W	Sand and gravel.
Spalding	W	W	Stone.
Stephens	W	W	Do.
Sumter	W	W	Clays, bauxite.
Talbot	754	W	Sand and gravel.
Taylor	W	W	Do.
Thomas	W	W	Clays, sand and gravel.
Tift	W	--	
Troup	W	W	Stone.
Twiggs	76,494	63,239	Clays.
Union	W	W	Sand and gravel, stone.
Walker	W	W	Stone, clays.
Walton	W	--	
Ware	204	204	Sand and gravel.
Warren	W	W	Clays, stone.
Washington	80,047	121,234	Clays.
Wheeler	W	W	Sand and gravel.
Whitfield	2,380	3,400	Stone.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Georgia, by county[1] —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Wilkinson	$43,513	$50,876	Clays.
Undistributed[2]	244,728	303,481	
Total	[3]474,363	588,114	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] The following counties are not listed because no nonfuel mineral production was reported: Appling, Atkinson, Baker, Banks, Ben Hill, Berrien, Bleckley, Brantley, Brooks, Bryan, Bulloch, Burke, Butts, Calhoun, Camden, Candler, Catoosa, Charlton, Chattahoochee, Chattooga, Clay, Clinch, Colquitt, Crisp, Dade, Dawson, Dodge, Dooly, Early, Echols, Emanuel, Fannin, Franklin, Glascock, Grady, Hancock, Haralson, Harris, Heard, Irwin, Jackson, Jeff Davis, Jenkins, Johnson, Lamar, Lanier, Liberty, McDuffie, McIntosh, Macon, Meriwether, Mitchell, Morgan, Muscogee, Newton, Oconee, Peach, Pulaski, Putnam, Randolph, Rockdale, Schley, Stewart, Taliaferro, Tattnall, Telfair, Terrell, Toombs, Towns, Treutlen, Turner, Upson, Wayne, Webster, White, Wilcox, Wilkes, and Worth.

[2] Includes gem stones and some clays that cannot be assigned to specific counties and values indicated by symbol W.

[3] Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Georgia business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	2,254.0	2,309.0	2,334.0	+1.1
Unemployment	do	156.0	131.0	119.0	-9.2
Employment (nonagricultural):					
Mining[1]	do	7.3	7.5	7.7	+2.7
Manufacturing	do	494.1	515.8	527.1	+2.2
Contract construction	do	91.6	101.2	98.1	-3.1
Transportation and public utilities	do	120.3	129.1	136.1	+5.4
Wholesale and retail trade	do	443.1	476.0	493.5	+3.7
Finance, insurance, real estate	do	100.0	103.6	107.0	+3.3
Services	do	286.0	309.1	326.9	+5.8
Government	do	384.0	407.9	417.7	+2.4
Total nonagricultural employment[1]	do	1,926.4	[2]2,050.1	2,114.1	+3.1
Personal income:					
Total	millions	$30,482	$34,465	$38,456	+11.6
Per capita		$6,047	$6,779	$7,515	+10.9
Construction activity:					
Number of private and public residential units authorized		33,543	[3]37,529	42,446	+13.1
Value of nonresidential construction	millions	$473.4	$600.0	$812.4	+35.4
Value of State road contract awards	do	$215.0	NA	$286.0	
Shipments of portland and masonry cement to and within the State	thousand short tons	2,261	2,409	2,289	-5.0
Nonfuel mineral production value:					
Total crude mineral value	millions	$474.4	$588.1	$698.7	+18.8
Value per capita, resident population		$94	$116	$137	+18.1
Value per square mile		$8,057	$9,988	$11,867	+18.8

[p] Preliminary. NA Not available.

[1] Includes bituminous coal extraction.

[2] Data do not add to total shown because of independent rounding.

[3] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Trends and Developments.—Construction continued on a new bulk storage warehouse and material handling system at the Georgia Port Authority's Brunswick facility. When the system is completed in 1980, annual throughput capabilities will be 125,000 tons. Market studies indicated that bulk tonnage of materials such as salt cake, fuller's earth, potash, fertilizers, solar salt, and nitrates will double within 15 years. Most foreign exports of kaolin pass through the Georgia Port Authority's Savannah facility, which also handles significant tonnages of bauxite, kyanite, and zircon sand.

According to published records, Georgia has produced almost $6 billion worth of

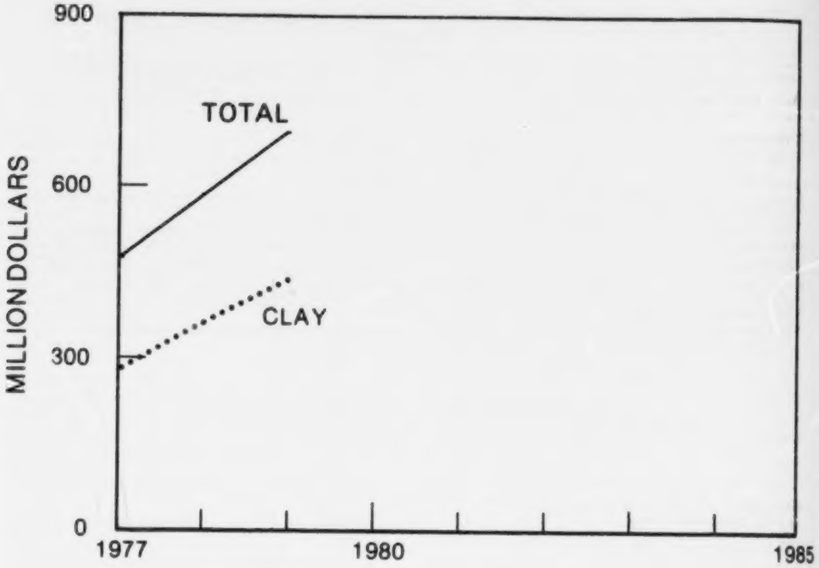

Figure 1.—Value of clays, and total value of nonfuel mineral production in Georgia.

minerals. To emphasize the importance of minerals to the State, the Cartersville Tourism and Industry Council opened a minerals and mining museum in 1979 that illustrates the mineral heritage of the Bartow County area and the rest of Georgia, while emphasizing the economic aspects of mineral production in Georgia. The museum is of interest to all ages, and many of the exhibits are participatory in nature.

Legislation and Government Programs.—Work continued at the Federal Bureau of Mines Engineering Laboratory in Boulder City, Nev., on the development of an economically viable process for extracting alumina from kaolin; Thiele Kaolin Co. supplied the kaolin from a mine in Washington County. During the first quarter of 1978, a 10-day miniplant test run was conducted using the hydrochloric acid (HCl) leach process with gas sparging crystallization.

A mineral appraisal team from the Federal Bureau of Mines' Eastern Field Operations Center (EFOC) completed a field survey in the proposed Ellicot Rock Wilderness Area, which includes portions of Georgia, North Carolina, and Tennessee, and in the proposed Cohutta Wilderness Area, Georgia. Reports for the Cohutta Area and the Big Frog Wilderness Study Area, which includes portions of Tennessee and Georgia, were completed and submitted for publication.

EFOC personnel inventoried active and abandoned mine locations in the State for updating the Bureau's Mineral Industry Location System, a computerized data storage and retrieval system that contains mine locations and other pertinent data for the Nation's mineral industry.

In a report prepared for the Bureau, Zellars-Williams, Inc., evaluated the phosphate resources in Georgia, North Carolina, and South Carolina. Georgia's phosphate resources are located in the Savannah area and south-central Georgia. The study identified resources of 15.1 billion tons of in-place ore, with a weighted average P_2O_5 content of 8.6%.

During the biennium, work continued on Georgia's Coastal Zone Management Program, and the State received a $553,436 grant to complete program development. A legal analysis and authorities paper was submitted to the Office of Coastal Zone Management in December 1978. However, in 1979, the Governor notified the U.S. Department of Commerce that the incentives offered for participation in the program were basically insufficient, and the State was dropping out of the program. The State is expected to develop and administer its own coastal management program to fit the State's needs.

In similar action, the Governor notified the U.S. Department of Interior's Office of Surface Mining that Georgia does not plan to develop a program consistent with the Federal Surface Mining Control and Reclamation Act of 1977. It was felt that the small number of coal mines in the State did not justify participation by the State in the program.

A 1979 study, commissioned by the Georgia Institute of Technology, concluded that the imposition of severance taxes on Georgia's mineral producers would be inappropriate because (1) revenues generated by severance taxes would be more than offset by a reduction in sales, (2) for those Georgia minerals sold locally, severance taxes would be passed on directly as a regressive tax, and (3) many of the marginal mineral reserves in Georgia would not be mined, with resulting waste of resources.

The State legislature passed a bill to provide for permitting and inspection of dams constructed in the State. The legislation, which included settling ponds and impoundments constructed for mineral operations, became effective July 1, 1978, and requires that dam construction, modification, and inspection be the responsibility of the Environmental Protection Division, Georgia Department of Natural Resources. The law requires certification by both a geologist and an engineer, stating that the dam design is safe and adequate to meet State standards.

The Georgia Division of Geology and Water Resources was reorganized as part of an economy move in the Department of Natural Resources. The Division was reassigned to a branch-level function, renamed the Georgia Geologic Survey, and placed under the Environmental Protection Division.

The Georgia Geologic Survey continued basic mapping, ground water investigations, airborne geophysical surveys, and environmental atlas work initiated in previous years. The Survey assisted the mineral industry in Georgia by evaluating (1) construction materials of the Georgia Coastal Plain, (2) geology and mineral resources of the mafic and ultramafic rocks of Georgia, (3) uranium and thorium in selected sands of coastal Georgia, and (4) uranium in graphitic phyllites and other selected rocks in the Georgia Piedmont and Blue Ridge.

At yearend, all but four of the 1,016 7-1/2-minute quadrangles that cover the State had been published, and the remaining four were completed in single-copy, advance sheet format.

During the period, the Georgia Institute of Technology was designated by the Secretary of the Interior as a State Mining and Mineral Resources and Research Institute pursuant to Title III of Public Law 95-87.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Nonmetals accounted for nearly all of the State's total mineral production value in 1978 and 1979. The principal nonmetals produced, in descending order of value, were clays, crushed stone, cement, dimension stone, and sand and gravel.

Barite.—Georgia ranked fourth nationally in the production of primary barite. Production in 1978 decreased, while value rose. Production in 1979 remained at about the same level as that of 1978. Barite production was limited to the Cartersville district in Bartow County in the northwestern part of the State. Although 23 companies have produced barite from the district, only two, New Riverside Ochre Co. and Paga Mining Co., are presently active. The barite concentrates were used in the manufacture of chemicals, as fillers and extenders in paint and rubber products, as a weighting material in drilling muds, and in glassmaking, flux, and heavy products. In 1978, New Riverside Ochre Co. and Paga Mining Co. conducted a drilling program for barite on jointly owned land in the Cartersville district; significant barite reserves reportedly were proven.

Paga Mining Co. maintained a 35-acre park in an abandoned barite mining area in the historic Cartersville District in northwest Georgia. Numerous trails allow access to geologic exposures that relate to barite

Table 4.—Georgia: Kaolin sold or used by producers, by kind and use

(Short tons)

Use	1977 Airfloat	1977 Unprocessed	1977 Water-washed[1]	1977 Total	1978 Airfloat	1978 Unprocessed	1978 Water-washed[1]	1978 Total	1979 Airfloat	1979 Unprocessed	1979 Water-washed[1]	1979 Total
Domestic:												
Adhesives	38,582	--	18,998	57,580	39,053	--	17,155	56,208	36,553	--	8,191	44,744
Alum (aluminum sulfate) and other chemicals	243	214,941	20,831	236,015	--	216,860	23,150	240,010	200	245,004	8,181	253,385
Animal feed	W	--	--	W	W	--	--	W	W	--	--	W
Asphalt tile and linoleum	36,128	--	--	36,128	37,004	2,980	--	39,984	38,871	4,670	--	43,541
Catalysts (oil refining)	W	--	W	87,046	W	--	W	50,401	W	W	W	62,171
China and dinnerware; crockery and earthenware	18,459	--	18,121	36,580	23,717	3,486	20,287	47,490	15,707	3,398	18,830	37,935
Electrical porcelain	W	--	W	23,147	W	--	W	15,569	16,894	--	--	16,894
Face brick	W	31,980	W	32,412	W	32,400	W	32,506	267	18,500	55	18,822
Fiberglass and mineral wool	58,221	--	--	58,221	101,871	--	--	101,871	109,807	--	2,393	112,200
Firebrick, block, shapes	14,177	13,904	23,457	51,538	1,083	14,123	--	15,206	536	11,112	--	11,648
Floor and wall tile, ceramic	W	--	W	8,725	W	--	W	21,472	W	--	W	13,248
Flue linings and high-alumina brick	39,327	14,168	--	53,495	41,687	14,994	--	56,681	41,195	13,043	--	54,238
Foundry sand	1,798	--	100	1,898	2,489	9,078	--	11,567	770	--	--	770
Glazes, glass, enamels, hobby ceramics	11,590	W	--	W	W	--	--	W	W	--	--	W
Grogs and crudes, refractory	3,024	295,418	--	298,442	22,333	318,042	--	340,375	18,533	400,270	17	418,820
Ink	W	--	W	12,000	--	--	W	745	W	--	--	W
Kiln furniture, mortar, cement	13,745	W	--	W	W	W	--	18,316	--	W	W	34,681
Medical, pharmaceutical, cosmetic	W	--	W	1,842	W	--	W	1,091	W	--	W	2,036
Paint	12,413	--	98,754	111,167	--	--	119,058	119,058	10,651	--	109,273	119,924
Paper coating	63,918	--	1,748,921	1,812,839	167,004	--	2,068,225	2,235,229	61,872	--	2,212,338	2,274,210
Paper filling	144,690	--	650,942	795,632	106,119	--	654,952	761,071	86,853	--	771,452	858,305
Plastics	3,212	--	55,096	58,308	3,596	--	58,423	62,019	2,436	--	53,487	55,923
Pottery	5,921	--	--	5,921	4,777	--	--	4,777	7,988	15,284	--	23,272
Roofing granules	W	--	W	19,590	W	W	--	26,877	W	--	W	12,646
Roofing and structural tile	35,561	--	--	35,561	1,526	--	--	1,526	--	4,995	--	4,995
Rubber	73,204	--	9,037	82,241	65,321	--	10,562	75,883	77,303	--	11,615	88,918
Sanitary ware	108,616	W	W	142,119	103,578	W	W	103,632	117,074	W	W	128,400
Miscellaneous airfloat:												
Fertilizer, oil and grease absorbents, pet waste absorbents, pesticides and related products, unknown	15,725	--	--	15,725	15,219	--	--	15,219	5,356	--	--	5,356
Miscellaneous, unprocessed:												
Gypsum products, common brick (1979), flower pots (1979), sewer pipe (1979), quarry tile (1979), portland cement (1979)	--	31,951	--	[2]22,039	--	33,176	--	33,176	--	23,891	--	23,891

Miscellaneous, water-washed:												
Gypsum products, pesticides and related products (1979), waterproofing and sealing, unknown, other	--	--	101,006	101,006	--	--	86,964	86,964	--	--	65,087	65,087
Undistributed	85,632	--	65,406	[2]	132,164	102,739	85,446	[2]185,718	49,424	92,563	83,142	[2]89,021
Total	784,186	602,362	2,810,669	4,197,217	868,541	747,878	3,144,222	4,760,641	698,290	832,730	3,344,061	4,875,081
Exports:												
Foundry sand	--	148,406	--	148,406	--	113,873	--	113,873	--	--	--	--
Paint	--	--	30,714	30,714	1,295	--	23,348	24,643	17,999	--	12,151	30,150
Paper coating	--	--	507,517	507,517	--	--	523,629	523,629	--	--	580,435	580,435
Paper filling	8,423	--	31,031	39,454	3,164	--	46,900	50,064	1,082	--	52,859	53,941
Plastics	--	--	20,348	20,348	--	--	18,401	18,401	--	--	23,324	23,324
Refractories	8,300	--	1,739	10,039	8,798	--	1,948	10,746	--	276,037	--	276,037
Rubber	198	--	862	1,060	7	--	740	747	78	--	843	921
Undistributed	152	3,850	24,853	28,855	1,552	--	27,539	29,091	--	172,069	47,151	219,220
Total	17,073	152,256	617,064	786,393	14,816	113,873	642,505	771,194	19,159	448,106	716,763	1,184,028
Grand total	801,259	754,618	3,427,733	4,983,610	883,357	861,751	3,786,727	5,531,835	717,449	1,280,836	4,060,824	6,059,109

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes calcined and delaminated.

[2] Incomplete total; remainder included in totals for specific uses.

mineralization and the major rock types in the area. Also areas can be reached that illustrate three distinct periods of mining. Pick, shovel, and wheelbarrow; steam shovel; and hydraulic mining. All exposures and mining areas are identified. A large geologic map with an explanatory text describing the stratigraphy and structure of the area is located at a scenic point. This park was approved by the Georgia Mined Land Reclamation Branch.

Cement.—Three companies, Medusa Cement Co., Marquette Cement Manufacturing Co., and Martin Marietta Corp., produced portland and masonry cement from plants located in Houston, Polk, and Fulton Counties, respectively.

End use of portland cement in 1978 was ready-mix concrete (49.1%), concrete products (16.5%), and highway contractors (15.3%); the balance was for other uses. The majority of shipments were made by truck.

Masonry cement production and value increased in 1978, then decreased slightly in 1979. Masonry cement constitutes a small fraction of total production.

Raw materials used were mainly cement rock, limestone, and clay, with smaller amounts of shale, sandstone, sand, iron ore, and gypsum.

The Department of Energy's Economic Regulatory Administration issued orders to the Atlanta cement facility of Martin Marietta Corp. prohibiting the use of oil and natural gas as a primary fuel. When the conversion is completed, the company will use an estimated 84,000 tons of coal per year.

Clays.—Georgia continued to lead the Nation in the production of clay. Total clay production and value increased in 1978; in 1979, production decreased while value increased. Clays mined in the State, in order of decreasing value, were kaolin, fuller's earth, and common clay.

Georgia led the Nation in production of kaolin. The State's industry in 1978 was composed of 21 companies operating 56 mines along the Fall Line kaolin belt in east-central Georgia. Production in 1978 totaled 5.5 million tons, valued at \$325.3 million; in 1979, production was 6.1 million tons, valued at \$404.2 million. Major uses for premium-grade kaolin were paper coating and filler applications. Most of the water-washed kaolin producers increased capacity in 1979 and plan further expansion in the future.

Many of the kaolin producers announced plans to expand their capacity over the next few years. Engelhard Minerals & Chemicals Corp. plans to spend over \$20 million to upgrade and expand facilities at McIntyre and add 100,000 tons per year to their capacity. The project is scheduled for completion early in 1981. Freeport Kaolin Corp. plans to spend \$22 million to increase production by 100,000 tons per year at Gordon. Anglo-American Clays Corp. was developing a calcined kaolin product that is expected to increase production by 30,000 tons per year. The high brightness, low abrasion calcined clays produced are used in paper filling and coating. Nord Kaolin Co. announced a second-stage expansion at its Jeffersonville operation. The project, to take 4 years, includes installation of a magnetic separator, a new spray dryer, and an expanded crude clay blending and processing system. Capacity is expected to increase to 300,000 tons per year by the end of 1980.

The largest bagged shipment of kaolin in history was exported by Engelhard Minerals & Chemicals Corp. Approximately 17,000 metric tons of kaolin was shipped from Engelhard's central Georgia mining operation to Savannah, Ga. The kaolin was destined for Japan, where it was used in manufacturing a premium-grade paper stock.

Engelhard Minerals & Chemicals Corp. completed a \$9 million expansion for making fluidized-bed cracking catalysts at the Attapulgus, Ga., facility. Kaolin mined in McIntyre, Ga., is fractionated, and special grades are sent for catalyst processing 200 miles away at the Attapulgus catalyst plant. The new expansion increased the plant capacity to 100 to 150 tons per day, depending on the type of catalyst produced.

Georgia ranked first in the Nation in the production of fuller's earth. In 1978, seven companies in Decatur, Houston, Jefferson, and Thomas Counties produced a total of 618,805 tons, valued at \$27.1 million; production and value increased slightly in 1979 over that of 1978.

Anschutz Minerals Corp., a subsidiary of the Denver-based Anschutz Corp., purchased a fuller's earth operation near Ochlocknee in Thomas County in the southwestern fuller's earth district. The plant, previously operated by Cherokee Industries and later by Control Packaging, Inc., was expanded to a 100,000-ton-per-year capacity.

Engelhard Minerals & Chemicals Corp. increased capacity at its Attapulgus fuller's earth plant. Output was doubled, and further expansions were underway in late 1979. Fuller's earth products have been finding increasing application in liquid fertilizers, paints, and oil well drilling muds.

Common clay and shale, used in brick, cement, and tile, was produced by 12 companies operating 19 pits in 10 counties. Production in 1978 increased 16.9% to 2.3 million tons, with value increasing 56.0% to $6.2 million. In 1979, production decreased to 1.6 million tons valued at $4.7 million.

Atlanta Brick and Tile Co., a subsidiary of the Jenkins Brick Co., announced plans for a $2 million expansion in the Atlanta area. Atlanta Brick and Tile will construct a new tunnel kiln that will double brick capacity and raise employment to 130.

Feldspar.—Georgia ranked third nationally in the production of feldspar. High-potash feldspar was mined from weathered pegmatite at the Monticello mine in Jasper

Table 5.—Georgia: Kaolin sold or used by producers, by kind

(Short tons)

Kind	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Airfloat	882,228	$20,709,493	883,357	$21,893,179	717,449	$20,483,169
Calcined	656,058	57,668,552	858,312	76,481,595	920,961	91,925,829
Delaminated	420,133	28,960,143	398,343	31,954,998	358,293	31,891,253
Unprocessed	308,087	1,077,116	317,975	1,339,717	359,875	2,483,198
Water-washed	2,717,104	153,449,022	3,073,848	193,596,761	3,702,531	257,402,172
Total	4,983,610	261,864,326	5,531,835	325,266,250	6,059,109	404,185,621

Table 6.—Georgia: Kaolin sold or used by producers, by use

(Short tons)

Use	1977	1978	1979
Domestic:			
Adhesives	57,580	56,208	44,744
Chemicals	236,015	240,010	253,385
Fiberglass and mineral wool	58,221	101,871	112,200
Firebrick, block, shapes	51,538	15,206	11,648
Floor and wall tile, ceramic	8,725	21,472	13,248
Paint	111,167	119,058	119,924
Paper coating	1,812,839	2,235,229	2,274,210
Paper filling	795,632	761,071	858,305
Plastics	58,308	62,019	55,923
Rubber	82,241	75,883	88,918
Sanitary ware	142,119	103,632	128,400
Whiteware	42,501	47,490	37,935
Other	740,331	921,492	876,241
Exports	786,393	771,194	1,184,028
Total	4,983,610	5,531,835	6,059,109

Table 7.—Georgia: Kaolin sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1977			1978			1979		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Sumter	W	W	W	W	W	W	W	W	W
Twiggs	6	1,343	76,494	5	1,078	63,239	6	1,193	77,218
Warren	W	W	W	W	W	W	3	697	38,916
Washington	5	1,542	80,047	9	2,004	121,234	6	1,902	131,949
Wilkinson	6	759	43,513	6	808	50,876	6	924	69,128
Other counties[1]	4	1,340	61,810	9	1,642	89,917	7	1,343	86,974
Total	21	4,984	261,864	29	5,532	325,266	28	6,059	404,186

W Withheld to avoid disclosing company proprietary data; included in "Other counties."

[1] Includes Columbia (1977), Houston, and Richmond Counties, and data indicated by symbol W.

County by The Feldspar Corp. Production in 1978 increased 8.3%, while value increased 41.7%; 1979 production and value increased 7.3% and 12.8%, respectively, over that of 1978.

In 1979, The Feldspar Corp. opened a new mine in Greene County. Ore is shipped by truck to the processing plant at Monticello. The plant is expected to be moved to the new mine in the early 1980's.

Gypsum.—Calcined gypsum and gypsum board products were produced by three firms from raw materials mined in other states. National Gypsum Co. and the Flintkote Co. in Chatham County, and the Gypsum Div. of Georgia-Pacific Corp. in Glynn County produced wallboard, cement retarder, fillers, and agricultural sand additives. American Cyanamid Co. recovered gypsum as a byproduct in a titanium plant in Savannah.

Kyanite-Mullite.—Georgia ranked second nationally in the production of kyanite. C-E Minerals, Inc., a division of Combustion Engineering, Inc., operated a surface mining operation and a flotation plant at Graves Mountain in Lincoln County. Production increased in 1978 and 1979.

Synthetic mullite, a product of sintering a mixture of aluminous and siliceous materials and aluminum silicate refractory grogs, was produced by Mulcoa Div. of C-E Minerals, Inc., in Sumter County.

Lime.—Although Georgia has abundant resources of high-quality limestone, none has been developed. Georgia's 1978 lime requirements were imported from surrounding States; consumption in 1978 increased slightly.

Mica.—Franklin Mineral Products Co., Inc., mined flake mica from an open pit mine in Hart County. Both production and value decreased in 1978 and again in 1979. The mica is ground for use as an extender and filler in various products including paint, wall paper, and rubber products.

Peat.—Two companies in Miller and Screven Counties produced peat for use as a potting medium and general soil conditioner. Production and value increased in 1978, and maintained the same level in 1979.

Perlite.—Armstrong Cork Co. expanded perlite at a plant near Macon in Bibb County. The product was used in acoustical tile, pipe insulation, and other lightweight insulating material. Raw material was obtained from mines in the Western United States.

Sand and Gravel.—Sand and gravel was produced in 1978 by 45 companies, operating 48 mines in 33 counties; industry structure was the same in 1979. Leading counties were Chatham, Crawford, Talbot, and Taylor. Although production increased, a lower unit value of $2.33 in 1978 compared with $2.57 in 1977, resulted in a lower total value. In 1979, unit value increased to $2.63 while production increased only slightly. Shipments were primarily by truck.

Stone.—Crushed stone production in 1978 increased for the fourth straight year but decreased slightly in 1979. Georgia ranked first in the production of dimension stone, which also had a slight increase in unit value. Dimension stone produced included granite, marble, and sandstone. Crushed stone produced included limestone, granite, marble, sandstone, and slate. In 1978, 51 companies produced crushed and/or dimension stone at 99 quarries; in 1979, 64 companies produced from 112 quarries. Although most dimension stone quarries produced

Table 8.—Georgia: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	2,896	$6,300	$2.18	2,994	$5,915	$1.98	3,348	$6,670	$1.99
Plaster and gunite sands	NA	NA	NA	196	320	1.63	230	418	1.81
Concrete products	270	642	2.37	316	774	2.45	256	660	2.58
Asphaltic concrete	639	2,114	3.31	471	1,602	3.40	360	1,249	3.47
Roadbase and coverings	300	590	1.97	377	809	2.15	393	1,165	2.96
Fill	645	753	1.17	737	866	1.18	353	454	1.29
Snow and ice control	NA	NA	NA	--	--	--	W	W	W
Railroad ballast	W	W	W	--	--	--	--	--	--
Other uses	60	97	1.35	7	24	3.50	70	178	2.54
Total[1] or average	4,809	10,496	2.18	5,097	10,310	2.02	5,014	10,792	2.15

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Data may not add to totals shown because of independent rounding.

relatively small tonnage, 21 crushed stone quarries each produced in excess of 900,000 tons of stone per year. Of the total stone tonnage, 91% was produced by eight companies.

Crushed stone was produced at 64 quarries in 1978 and 67 quarries in 1979. Leading producers were Vulcan Materials Co., Martin Marietta Aggregates, and Ivy Corp. Shipments were mainly by truck, followed by railroad, waterway, and other. Crushed stone was used mainly for dense road base, concrete and bituminous aggregate, railroad ballast, and cement manufacture.

Dimension stone was produced at 37 quarries in 1978 and 46 quarries in 1979 for rough monumental stone, dressed monumental stone, and rough blocks. The State's dimension granite industry was centered in Elbert County, northeast of Atlanta, while the dimension marble and sandstone industries were located in Pickens County, north of Atlanta.

Martin Marietta Aggregates completed an $8.5 million expansion program at its Macon, Ga., crushed stone plant. Capacity of the operation increased from 1,000 to more than 1,500 tons per hour. Principal elements of the expansion were a $3.1 million gyratory crusher, a $2.4 million expansion of stone-sizing facilities, a $1.5 million improvement of rail and truck-loading facilities, and a new $1.5 million electric shovel.

Rosario Resources, Inc., sold its wholly owned subsidiary, Dixie Lime and Stone Co., to Florida Rock Industries, Inc. Three active crushed stone quarries and one inactive quarry in Georgia, and one dolomite quarry in Florida were included for a reported $12 million.

The Georgia Marble Co., a subsidiary of Jim Walters Corp., and the Nation's largest producer of crushed marble, began work to divert the East Branch of Long Swamp Creek at the company's New York Mine at Marble Hill, Ga. The relocation of the creek will allow development of a new portal and shorter mileage distance into the lower levels of the New York Mine. Output is used for extender and filler applications.

The Tate Div. of the Georgia Marble Co. opened a new dimension marble quarry at the southern end of the Tate quarry complex. The general area in Pickens County has been the scene of dimension marble quarrying since the 1840's. The new quarry will produce Cherokee-type marble, the principal variety of marble quarried in the district.

The outlook for the crushed stone industry is cautious optimism; for large operations there is sufficient work to run through 1980, while small operators do not have the advantage of long-term contracts. The expansion of Hartsfield International Airport near Atlanta, improvements to the Interstate system, and subway construction in the Atlanta area indicate continued demand for crushed stone.

Talc.—The Southern Talc Co. produced talc from two underground mines in the Fort Mountain area of Murray County. The crude talc was trucked to the Chatsworth mill where it was ground for use in ceramics, insecticides, roofing, rubber, and various other products.

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Bauxite.—Georgia was one of three bauxite-producing States in the Nation. Production decreased in 1978 and 1979. Bauxite was used in refractories and aluminum-based chemicals.

Table 9.—Georgia: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	3,496	$6,762	$1.93	4,220	$7,539	$1.79	4,110	$7,736	$1.88
Gravel	1,313	3,735	2.84	877	2,770	3.16	904	3,057	3.38
Total[1] or average	4,809	10,496	2.18	5,097	10,310	2.02	5,014	10,792	2.15
Industrial sand	332	2,711	8.17	281	2,242	7.98	W	W	W
Grand total[1] or average	5,141	13,207	2.57	5,378	12,550	2.33	W	W	W

W Withheld to avoid disclosing company proprietary data.

[1] Data may not add to totals shown because of independent rounding.

Table 10.—Georgia: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	229	695	193	604	453	2,219
Concrete aggregate	r7,219	r20,217	7,338	23,433	6,992	25,530
Bituminous aggregate	6,287	16,524	7,320	21,587	7,328	25,601
Macadam aggregate	--	--	W	453	--	--
Dense-graded roadbase stone	9,750	25,618	11,576	34,214	8,158	26,289
Surface treatment aggregate	687	1,588	855	2,670	1,857	5,986
Other construction aggregate and roadstone	5,515	14,161	5,996	17,305	9,051	30,428
Riprap and jetty stone	89	284	152	561	120	471
Railroad ballast	2,745	6,130	2,566	6,821	2,823	8,080
Manufactured fine aggregate (stone sand)	469	913	945	2,742	345	1,163
Cement manufacture	1,304	2,370	1,668	3,305	1,518	3,343
Asphalt filler	79	166	--	--	W	W
Slate flour	--	--	--	--	20	300
Lightweight aggregate	W	2,400	W	W	W	W
Other uses[2]	3,491	15,149	2,962	18,263	2,237	24,609
Total[3]	37,864	106,215	41,572	131,959	40,902	154,021

rRevised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, marble, sandstone and slate.

[2] Includes stone used for filter stone, terrazzo and exposed aggregate, abrasives (1979), whiting (1979), other filler, roofing granules (1977-78), building products (1977-78), unspecified uses, and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 11.—Georgia: Dimension stone[1] sold or used by producers, by use

Use	1977			1978			1979		
	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)
Rough blocks	17,025	163	$509	44,309	434	$1,239	53,551	511	$1,545
Irregular-shaped stone	43,568	493	1,510	33,432	359	1,031	37,961	428	1,727
Rubble	r13,103	137	130	21,940	246	271	11,938	136	181
Rough monumental	r148,196	1,506	5,642	133,953	1,351	5,223	111,846	1,146	5,606
Rough flagging	3,162	35	123	W	W	W	W	W	W
Dressed monumental	11,919	135	4,541	14,436	164	5,714	7,688	75	1,673
Other uses[2]	3,488	41	1,182	29,211	324	2,400	21,406	240	7,176
Total[3]	240,461	2,511	13,637	277,281	2,877	15,879	244,390	2,535	17,908

rRevised. W Withheld to avoid disclosing commpany proprietary data; included with "Other uses."

[1] Includes limestone, granite, marble, sandstone, and slate.

[2] Includes stone used for cut stone, sawed stone, curbing, dressed flagging (1979), and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Gold.—With the increase in the price of gold in 1979, panning and dredging of stream gravels increased. Several major gold producers initiated exploration programs in the State.

Iron Ore.—There was no reported production of iron ore in 1978 or 1979. Depletion of known shallow reserves and high reclamation costs were given as reasons for cessation of operations in 1977.

Iron Oxide Pigments.—Georgia was one of four States with crude iron oxide pigment production and ranked second nationally. Ochre and umber production by the New Riverside Ochre Co. was produced from surface mined material in Bartow County.

Titanium-Zirconium.—Heavy minerals mined and concentrated in Florida were shipped to the Folkston plant, owned by Humphrey's Mining Co., for ilmenite and zircon recovery. The Folkston plant has used Florida concentrate since 1978, when the Georgia deposits were depleted.

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[1] State mineral specialist, Bureau of Mines, Tuscaloosa, Ala.

[2] State geologist, Georgia Geologic Survey, Environmental Protection Division, Georgia Department of Natural Resources.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Barite, primary:			
New Riverside Ochre Co	Box 387 Cartersville, GA 30120	Open pit mine	Bartow.
Paga Mining Co	Box 130 Cartersville, GA 30120	do	Do.
Bauxite:			
American Cyanamid Co	Berdan Ave. Wayne, NJ 07470	Open pit mine and plant.	Sumter.
C-E Minerals, Inc	901 East 8th Ave. King of Prussia, PA 19406	Open pit mine	Do.
Cement:			
Marquette Cement Manufacturing Co	20 North Wacker Dr. Chicago, IL 60606	Plant	Polk.
Martin Marietta Cement Corp	18th Floor, Daniel Bldg. Birmingham, AL 35233	do	Fulton.
Medusa Cement Co	Box 5668 Cleveland, OH 44101	do	Houston.
Clays:			
American Industrial Clay Co	433 North Broad St. Elizabeth, NJ 07207	Open pit mines.	Warren and Washington.
Engelhard Minerals & Chemical Corp	Menlo Park Edison, NJ 08817	do	Decatur.
Freeport Kaolin Co	733 3d Ave. New York, NY 10017	do	Twiggs.
J. M. Huber Co	Thornall St. Edison, NJ 08817	do	Twiggs and Warren.
Feldspar:			
The Feldspar Corp	Box 99 Spruce Pine, NC 28777	Open pit mine and plant.	Jasper.
Gypsum:			
The Flintkote Co	400 Westchester Ave. White Plains, NY 10604	Plant	Chatham.
Georgia Pacific Corp	Box 311 Portland, OR 97207	do	Glynn.
National Gypsum Co	4100 First International Bldg. Dallas, TX 75270	do	Chatham.
Kyanite:			
C-E Minerals, Inc	433 Gulph Rd. King of Prussia, PA 19406	Open pit mine and plant.	Lincoln.
Mica:			
Franklin Mineral Products Co., Inc	Box O Wilmington, MA 01887	Open pit mine	Hart.
Peat:			
Shep Peat Co	Box 307 Colquitte, GA 31737	Bog	Miller.
Perlite, expanded:			
Armstrong Cork Co	1010 Concord Lancaster, PA 17604	Plant	Bibb.
Sand and gravel:			
Brown Brothers Sand Co	Howard, GA 31039	Open pit mines.	Talbot and Taylor.
Colwell Construction Co	Box 6 Blairsville, GA 30512	Open pit mine	Upson.
Crawford County Mining Co., Inc	3166 Maple Dr. Atlanta, GA 30305	do	Crawford.
Dawes Silica Mining Co	Box 470 Thomasville, GA 31792	Open pit mines.	Dougherty, Effingham, Thomas.
Howard Sand Co	Box 118 Butler, GA 31006	do	Talbot and Taylor.
Stone:			
Florida Rock Industries, Inc	Box 4667 Jacksonville, FL 32201	Quarries	Fayette, Floyd, Spalding.
Georgia Marble Co	3460 Cumberland Pkwy., NW. Atlanta, GA 30303	do	De Kalb, Douglas, Gilmer, Pickens.
Ivy Corp	100 Peachtree St. Atlanta, GA 30303	do	Clarke, Fulton, Habersham, Hall, Stephens.
Martin Marietta Aggregates	6801 Rockledge Dr. Bethesda, MD 20034	do	Columbia, Jones, Lee, Richmond, Warren.
Vulcan Materials Co	Box 7324-A, 1 Office Park Birmingham, AL 35223	do	Carroll, Cobb, Coweta, Douglas, Fulton, Greene, Gwinnett, Henry, Troup.
Talc:			
Southern Talc Co	Box F Chatsworth, GA 30705	Mines and mill.	Murray.

The Mineral Industry of Hawaii

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Department of Land and Natural Resources of the State of Hawaii for collecting information on all nonfuel minerals.

By George T. Krempasky[1]

Hawaii's nonfuel mineral production reached a record high, mainly as a result of cement production. Nonfuel mineral production totaled $53 million in 1978 and $64 million in 1979. Use of mineral commodities—cement, stone, sand and gravel, and pumice— was directly related to the construction industry. Portland cement replaced stone as the leading value commodity produced, reflecting an upsurge in exports to west coast ports in response to mainland shortages.

Cement was manufactured at two plants in Honolulu County. Pumice and volcanic cinder was mined in Hawaii, Kauai, and Maui Counties. Sand and gravel was mined in Hawaii, Kauai, and Maui Counties. Crushed stone was produced from quarries in Hawaii, Honolulu, Kauai, and Maui Counties. Vermiculite imported from Montana was exfoliated in Honolulu County. Gem stone material, black, pink, and gold coral for use in making jewelry, was harvested from the waters surrounding the Hawaiian Islands.

Pacific Concrete & Rock Co., Ltd., closed its rock quarry and ready-mix facility at Honokohau, near Kona. The company will continue supplying customers from rock quarries at Waimanalo and Makakilo, and from its main concrete facilities in the Sand Island area of Honolulu.

Ameron Honolulu Construction and Drayage, Ltd., was granted a 20-year extension to its special-use permit for rock quarrying and processing at its Puunene quarry in Maui County. The permit now includes 194 acres.

Ocean Minerals Co. of Mountain View, Calif., a consortium of Lockheed Missiles and Space Co., Amoco Minerals Co., and two Dutch companies, announced that its ship had successfully recovered manganese nodules in 17,000 feet of water 800 to 1,000 miles southeast of Hawaii. Nearly 1,000 tons were mined in a continuous stream in the first successful test of a mining system at that depth. Ocean Mining Associates (United States Steel Corp., Union Miniere, S.A., and Sun Oil Co.), in its test program, successfully raised manganese nodules from a 3-mile depth at design capacity of 50 tons per hour. Another consortium of companies from Germany, Japan, the United States, and Canada, operating as Ocean Management, Inc., announced it too had successfully demonstrated continuous mining of nodules. Despite successful tests, mining of the sea floor has been postponed until the Law of the Sea can be clarified.

The long-term effort to codify the Law of the Sea, at sessions of the Law of the Sea Conference, has not materialized. The deep seabed mining issue, including the right of private companies to engage in commercial production of manganese nodules, has been a stumbling block. A deep sea mining bill was introduced in the U.S. Congress. The proposed bill is intended as an interim measure for orderly development of deep seabed mining until an international agreement has been reached by the United Nations' Law of the Sea Conference. Until the issue can be resolved, private companies are reluctant to proceed. Investments in ocean mining already exceed $100 million.

As part of its Deep Ocean Mining Environmental Study (DOMES) Project, the National Oceanic and Atmospheric Agency (NOAA) is conducting a study of potential environmental effects involved in building a processing plant for manganese nodules in various States, among them, Hawaii. Under a grant from NOAA, the Hawaii Department of Planning and Economic Development is investigating possible effects that a nodule processing industry might have on the State. The State is actively encouraging potential nodule mining companies to consider locating their processing facilities in Hawaii.

Table 1.—Nonfuel mineral production in Hawaii[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:						
Portland thousand short tons	320	$16,315	441	$25,626	469	$29,346
Masonry do	10	607	11	828	12	1,077
Pumice do	260	574	272	658	359	1,240
Sand and gravel do	771	2,452	706	1,582	1,081	3,063
Stone:						
Crushed do	5,758	19,876	6,327	23,845	6,868	28,969
Dimension do	1	4	W	W	1	W
Combined value of other nonmetals	XX	152	XX	209	XX	209
Total	XX	39,980	XX	52,748	XX	63,904

W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Hawaii, by county

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Hawaii	W	$3,780	Stone, pumice, sand and gravel.
Honolulu	W	W	Cement, stone.
Kauai	W	W	Stone, sand and gravel, pumice.
Maui	$3,756	W	Stone, sand and gravel, pumice, lime, gem stones.
Total	39,980	52,748	

W Withheld to avoid disclosing company proprietary data; included in "Total."

Table 3.—Indicators of Hawaii business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	402.0	400.0	399.0	-0.3
Unemployment do	30.0	31.0	25.0	-19.4
Employment (nonagricultural):				
Mining do	([1])	([1])	([1])	--
Manufacturing do	23.2	23.7	23.6	-.4
Contract construction do	19.7	20.7	22.9	+10.6
Transportation and public utilities do	28.2	28.8	30.4	+5.6
Wholesale and retail trade do	92.2	97.9	104.5	+6.7
Finance, insurance, real estate do	25.6	28.8	30.3	+5.2
Services do	[2]84.8	[2]90.3	[2]98.4	+9.0
Government do	85.7	87.1	86.5	-.7
Total nonagricultural employment do	359.4	377.3	396.6	+5.1

See footnotes at end of table.

Table 3.—Indicators of Hawaii business activity —Continued

	1977	1978	1979^p	1978-79 percent change
Personal income:				
Total ---------- millions	$6,746	$7,490	$8,474	+13.1
Per capita ----------	$7,669	$8,465	$9,358	+10.5
Construction activity:				
Number of private and public residential units authorized ----------	7,916	9,475	10,887	+14.9
Value of nonresidential construction ---------- millions	$128.8	$179.3	$253.3	+41.3
Value of State road contract awards ---------- do	$51.0	$41.0	$41.4	+1.0
Shipments of portland and masonry cement to and within the State ---------- thousand short tons	318	392	434	+1.1
Nonfuel mineral production value:				
Total crude mineral value ---------- millions	$40.0	$52.7	$63.9	+21.2
Value per capita, resident population ----------	$45	$59	$70	+18.6
Value per square mile ----------	$6,198	$8,177	$9,908	+21.2

[p] Preliminary.
[1] Included with "Services."
[2] Includes mining.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Basic or bench-model research efforts related to the processing of nodules have been carried out at various places. The most likely site for pilot plant testing of processes deemed attractive by researchers is in Hawaii. Ocean Minerals Co. announced plans to build a $4 million pilot plant at Campbell Industrial Park on Oahu.

Against this background, Hawaii is emerging as a favored site for a possible manganese nodule mining and processing center. The black, potato-sized nodules, which contain 25% manganese and 3% combined nickel, copper, and cobalt, are found in vast areas southeast of Hawaii in 14,000 to 18,000 feet of water. As the nearest land, Hawaii is the logical site for a processing plant, provided environmental problems can be resolved or mitigated, and adequate land, water, and energy resources can be made available. Initial estimates indicate such a plant could provide employment for more than 1,200 people and produce annual revenue of $250 to $350 million.

Hawaii's economic dependence on tourism and Federal spending increases the importance of a new industry for the State.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Kaiser Cement & Gypsum Corp. and Cyprus Hawaiian Cement Corp. operated cement plants in Honolulu County, Oahu Island. Value of production of portland cement was greater than value of production of other nonfuel mineral commodities. Plant operations differ: Kaiser employs a wet process and Cyprus employs a dry process. Both plants use fuel oil for their kilns. Electricity for the Cyprus plant is purchased; Kaiser generates its own.

Portland cement was used by building material dealers, concrete product manufacturers, ready-mix companies, government agencies, and miscellaneous customers including exporters. More than 80% of sales were to ready-mix consumers.

Gem Stones.—Black, pink, and some gold coral was harvested from waters surrounding the Hawaiian Islands to provide raw materials for jewelry. The main source of precious coral has been the bed off Makapuu. A newly discovered bed found about 40 miles northwest of Nihoa, one of the leeward islands 290 miles northwest of Honolulu, is reported to be larger than that off Makapuu. Coral has been harvested from the waters off Maui and Kauai Islands by independent scuba divers. Maui Divers of Hawaii Ltd., acquired by Helena Rubenstein in 1977 through its wholly owned subsidiary, Deepwater Explorations, Ltd., handles diving and coral collection operations. The company uses a deep-diving submarine to depths of 1,200 feet.

Local jewelry manufacturing employs more than 500 people. The major jewelry producer is Helena Rubenstein.

Lime.—The Hawaiian Commercial & Sugar Co., Ltd., produced lime hydrate at Paia, Maui County. Quantity produced remained fairly constant; however, value received increased considerably.

Pumice and Volcanic Cinder.—Pumice and volcanic cinder was extracted in Hawaii, Kauai, and Maui Counties. Fifteen operators recovered material from 16 pits for use as concrete aggregate, in road construction, and as fill. Output of pumice and volcanic cinder is contingent upon requirements of the construction industry.

Sand and Gravel.—Six plants processed sand and gravel obtained from seven pits in Hawaii, Kauai, and Maui Counties. Two-thirds of the material produced came from Maui County. Main uses for the product were in concrete aggregate, fill, asphaltic aggregate, roadbase, and concrete production. Based on quantity, in excess of 70% of the material produced was used for concrete aggregate and fill. Of the total quantity produced, approximately 82% was transported by truck; the remainder was used onsite.

Table 4.—Hawaii: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	263	$1,137	$4.32	197	$584	$2.97	W	W	W
Plaster and gunite sands	NA	NA	NA	--	--	--	--	--	--
Concrete products	2	9	3.89	31	2	3.46	--	--	--
Asphaltic concrete	113	748	6.61	W	W	W	334	$1,395	$4.18
Roadbase and coverings	71	120	1.71	85	151	1.79	362	903	2.49
Fill	322	438	1.36	322	438	1.36	W	W	W
Other uses	--	--	--	102	407	3.98	--	--	--
Total or average	771	2,452	3.18	706	1,582	2.24	1,081	3,063	2.83

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses" and/or "Total or average."

Table 5.—Hawaii: Construction sand and gravel sold or used by producers

	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	369	$1,527	$4.14	W	W	W	540	$1,515	$2.81
Gravel	402	925	2.30	W	W	W	542	1,548	2.86
Total[1] or average	771	2,452	3.18	706	$1,582	$2.24	1,081	3,063	2.83

W Withheld to avoid disclosing company proprietary data; included in "Total or average."

[1] Data may not add to totals shown because of independent rounding.

Stone.—Crushed and dimension stone were produced from 32 quarries in Hawaii, Honolulu, Kauai, and Maui Counties. More than 75% of the crushed stone came from Honolulu County. All material was transported to users by truck. Quarry production ranged from less than 25,000 tons per year to more than 900,000 tons annually. Approximately 93% of total production came from quarries producing 100,000 tons per year or more.

Expansion of the Puunene quarry of Ameron Honolulu Construction and Drayage, Ltd., is scheduled for 1980. The Maui Planning Commission approved a 20-year extension to its special use permit for rock quarrying and permitted expansion of the quarry from 28 to 194 acres. The original 28-acre parcel is nearly exhausted; additional reserves are needed to supply rock and concrete products to the construction industry on Maui.

Pacific Concrete & Rock Co., Ltd., in November 1978, sold its rock quarry and ready-mix facility at Honokohau near Kona to Allied Aggregates of Hilo. Pacific Concrete & Rock will continue supplying its customers from a block manufacturing plant at Campbell Industrial Park, rock quarries at Waimanalo and Makakilo, and from its main facility in the Sand Island area of Honolulu.

Twenty-one companies were engaged in mining stone. Principal producers, with more than 100,000 tons per year, included Ameron Honolulu Construction and Drayage, Ltd.; Lone Star Industries; Pacific Concrete & Rock Co., Ltd.; Cyprus Hawaiian Cement Corp.; Herbert Tanaka Co.; Kaiser Cement & Gypsum Corp.; Grove Farm Co., Inc.; James W. Glover, Ltd.; Hawaiian Bitumuls & Paving Co.; Hilo Coast Processing Co.; and Yamada and Sons, Inc. The principal uses for stone—consumption in excess of 500,000 tons per year—were in concrete aggregate, roadbase, cement manufacturing, roadstone, bituminous aggregate, and sand.

Table 6.—Hawaii: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	22	90	30	125	16	85
Poultry grit and mineral food	3	14	2	13	2	W
Concrete aggregate	1,074	4,329	1,445	6,943	1,642	8,448
Bituminous aggregate	656	2,493	741	3,183	480	2,107
Dense-graded roadbase stone	1,604	4,490	1,039	2,710	1,329	3,920
Surface treatment aggregate	147	565	223	842	146	597
Other construction aggregate and roadstone	561	1,602	838	2,766	1,454	5,082
Riprap and jetty stone	W	W	77	329	43	W
Railroad ballast	--	--	2	W	2	W
Filter stone	--	--	2	6	--	--
Manufactured fine aggregate (stone sand)	595	3,183	705	4,626	783	5,755
Cement manufacture	734	1,777	895	2,155	935	2,490
Chemicals	6	33	7	36	W	W
Bedding materials	21	93	W	W	W	W
Porcelain	1	W	--	--	--	--
Other uses[2]	335	1,206	21	110	36	486
Total[3]	5,758	19,876	6,027	23,845	6,868	28,969

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, traprock, and miscellaneous stone.

[2] Includes macadam aggregate, fill (1977), terrazzo and exposed aggregate (1977), lime manufacture (1977-78), and roofing granules.

[3] Data may not add to totals shown because of independent rounding.

Vermiculite.—Vermiculite of Hawaii, Inc., exfoliated vermiculite from Montana at its Honolulu plant in Honolulu County. In descending order of quantity, the product was used in plaster aggregate, roofing aggregate, soil conditioning, loose fill insulation, and concrete aggregate.

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[1] State mineral specialist, Bureau of Mines, Spokane, Wash.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Cyprus Hawaiian Cement Corp	1600 Kapiolani Blvd. Honolulu, HI 96814	Cement plant	Honolulu.
Kaiser Cement & Gypsum Corp	Waianae Plant 300 Lakeside Dr. Oakland, CA 94666	do	Hawaii.
Lime:			
Hawaiian Commercial & Sugar Co., Ltd.	Box 266 Puunene, HI 96784	Rotary kiln and continuous hydrator.	Maui.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Pumice and volcanic cinder:			
James W. Glover, Ltd	Box 275 Hilo, HI 96720	Open pit mine	Hawaii.
HC & D, Ltd	Box 190 Honolulu, HI 96810	do	Maui.
Laupahoehoe Sugar Co	Papaaloa, HI 96780	do	Hawaii.
Hilo Coast Processing Co	Papaikou, HI 96788	do	Do.
Sand and gravel:			
Ameico Corp	645 Halekauwila St. Honolulu, HI 96813	Plant and pit	Maui.
Stone:			
HC & D, Ltd	Box 190 Honolulu, HI 96810	Quarry	Hawaii and Maui.
Lone Star Industries	400 Alabama St. San Francisco, CA 94110	do	Hawaii.
Pacific Concrete & Rock Co., Ltd	2344 Pahounui Dr. Honolulu, HI 96819	do	Honolulu and Maui.
Cyprus Hawaiian Cement Corp	1600 Kapiolani Blvd. Honolulu, HI 96814	do	Honolulu.
Kaiser Cement & Gypsum Corp	300 Lakeside Dr. Oakland, CA 94666	do	Hawaii.
Grove Farm Co., Inc	Puhi Rural Station Puhi, HI 96766	do	Kauai.
James W. Glover, Ltd	Box 275 Hilo, HI 96720	do	Hawaii.
Hawaiian Bitumuls & Paving Co., Ltd.	Box 2240 Honolulu, HI 96804	do	Honolulu.
Vermiculite (exfoliated):			
Vermiculite of Hawaii, Inc	842-A Mapunapuna St. Honolulu, HI 96819	Exfoliating plant	Do.

The Mineral Industry of Idaho

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Idaho Bureau of Mines and Geology, Idaho Department of Lands, for collecting information on all nonfuel minerals.

By D. W. Lockard[1] and E. H. Bennett[2]

The value of Idaho's nonfuel mineral production for 1978 was $299 million, and for 1979 it was $438 million. This dramatic increase in production values during the past 2 years was the result of rising metal prices, primarily gold and silver, and the lack of significant labor problems in the entire mineral sector. A 24-day strike at Hecla Mining Co.'s Lucky Friday Mine in 1978 was the only shutdown stemming from a labor-management controversy.

Silver was the leading metallic mineral commodity in terms of revenue; it was followed, in descending order, by values of phosphate rock, lead, and zinc. Metallic minerals accounted for nearly 70% of total mineral revenues in both 1978 and 1979.

Higher mineral prices prevailed throughout 1978 and into 1979, with dramatic increases shown in the latter half of the year. Of special importance were increased values of silver and gold with lesser increases in base metals (copper, lead, and zinc). Precious metals demand is expected to continue through 1980; it should favorably affect mining in the State since Idaho produces approximately 50% of the Nation's newly mined silver.

Although governmental regulations had a dampening effect on the State's mineral industry, increased metal prices and strengthening markets were positive through 1978-79. Federal land-use classifications continued to affect exploration in several areas throughout the State.

Table 1.—Nonfuel mineral production in Idaho[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony ore and concentrate, antimony content ---- short tons	446	W	W	W	W	W
Clays ---- thousand short tons	W	W	27	$148	28	$263
Copper (recoverable content of ores, etc.) ---- metric tons	3,676	$5,413	3,888	5,701	3,618	7,421
Gem stones ----	NA	100	NA	50	NA	60
Gold (recoverable content of ores, etc.) ---- troy ounces	12,894	1,912	20,492	3,966	24,140	7,423
Lead (recoverable content of ores, etc.) ---- metric tons	42,872	29,016	44,761	33,256	42,636	49,479
Phosphate rock ---- thousand metric tons	W	W	4,461	80,765	4,880	95,728
Sand and gravel ---- thousand short tons	[2]7,750	[2]15,282	8,112	19,290	[2]7,719	[2]18,149

See footnotes at end of table.

Table 1.—Nonfuel mineral production in Idaho[1] —Continued

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Silver (recoverable content of ores, etc.) thousand troy ounces	15,292	$70,649	18,379	$99,249	17,144	$190,129
Stone[3] thousand short tons	3,077	8,005	2,624	6,670	2,952	8,787
Zinc (recoverable content of ores, etc.) metric tons	28,121	21,327	32,353	22,111	29,660	24,391
Combined value of barite (1977-78), cement, garnet (abrasives), gypsum, lime, perlite, pumice, sand and gravel (industrial, 1977-78), stone (dimension), tungsten ore (1977), vanadium, and values indicated by symbol W	XX	100,966	XX	28,021	XX	36,055
Total	XX	252,670	XX	299,227	XX	437,885

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes industrial sand; value included in "Combined value" figure.

[3] Excludes dimension stone; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Idaho, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Ada	$2,269	$2,791	Sand and gravel.
Adams	1,898	W	Copper, stone, silver, sand and gravel.
Bannock	W	W	Cement, stone, sand and gravel.
Bear Lake	780	772	Sand and gravel, stone.
Benewah	W	W	Garnet, sand and gravel, clays, stone.
Bingham	W	W	Phosphate rock, sand and gravel.
Blaine	W	W	Barite, gold, silver.
Boise	(2)	(2)	Stone.
Bonner	W	345	Sand and gravel, stone.
Bonneville	W	2,712	Sand and gravel, lime, pumice, stone.
Boundary	W	121	Stone, sand and gravel.
Canyon	W	W	Sand and gravel, lime.
Caribou	70,768	81,352	Phosphate rock, vanadium, stone, sand and gravel.
Cassia	W	W	Sand and gravel, stone.
Clark	W	W	Do.
Clearwater	412	466	Stone.
Custer	W	1,130	Silver, lead, zinc, sand and gravel, stone.
Elmore	W	W	Sand and gravel, stone, clays, gold, silver.
Franklin	142	158	Stone, sand and gravel.
Fremont	533	533	Stone.
Gem	W	1,697	Sand and gravel, stone.
Gooding	508	W	Sand and gravel.
Idaho	1,021	W	Stone, sand and gravel.
Jefferson	422	--	
Jerome	166	115	Sand and gravel.
Kootenai	W	W	Sand and gravel, stone, silver, gold, copper, lead, zinc.
Latah	W	W	Stone, clays.
Lemhi	W	139	Stone, sand and gravel, gold, gypsum, zinc, copper, lead, silver.
Lewis	125	171	Stone.
Lincoln	W	148	Sand and gravel.
Madison	827	1,822	Do.
Minidoka	W	W	Lime, sand and gravel.
Nez Perce	W	1,342	Stone, sand and gravel.
Oneida	W	W	Perlite, pumice, stone.
Owyhee	W	W	Silver, gold, lead, zinc.
Payette	308	130	Sand and gravel.
Power	W	350	Stone, sand and gravel.
Shoshone	W	W	Silver, lead, zinc, copper, antimony, gold, stone.
Teton	287	40	Sand and gravel.
Twin Falls	W	W	Sand and gravel, lime.
Valley	W	146	Stone, sand and gravel.
Washington	W	W	Sand and gravel, gypsum, stone.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Idaho, by county[1] —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Undistributed[3]	$172,196	$202,748	
Total[4]	252,670	299,227	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1] Butte and Camas Counties are not listed because no nonfuel mineral production was reported.
[2] Less than 1/2 unit.
[3] Includes stone that cannot be assigned to specific counties (1977), gem stones, and values indicated by symbol W.
[4] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Idaho business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	389.0	407.0	422.0	+3.7
Unemployment do.	23.0	23.0	24.0	+4.3
Employment (nonagricultural):				
Mining do.	3.4	3.9	4.1	+5.1
Manufacturing do.	54.1	58.1	58.6	+.9
Contract construction do.	19.0	19.8	18.6	-6.1
Transportation and public utilities do.	18.0	19.5	20.2	+3.6
Wholesale and retail trade do.	76.8	82.1	83.4	+1.6
Finance, insurance, real estate do.	16.4	20.8	22.9	+10.1
Services do.	52.4	57.1	59.9	+4.9
Government do.	67.3	69.8	69.5	-.4
Total nonagricultural employment do.	307.4	[1]331.3	337.2	+1.8
Personal income:				
Total millions	$5,301	$6,207	$6,739	+8.6
Per capita	$6,193	$7,074	$7,446	+5.3
Construction activity:				
Number of private and public residential units authorized	12,722	[2]10,468	8,485	-18.9
Value of nonresidential construction millions	$106.3	$117.5	$116.0	-1.3
Value of State road contract awards do.	$50.0	$40.0	$50.7	+26.7
Shipments of portland and masonry cement to and within the State thousand short tons	512	461	473	+2.6
Nonfuel mineral production value:				
Total crude mineral value millions	$252.7	$299.2	$437.9	+46.4
Value per capita, resident population	$295	$341	$484	+41.9
Value per square mile	$3,024	$3,581	$5,241	+46.4

[p] Preliminary.
[1] Data do not add to total shown because of independent rounding.
[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

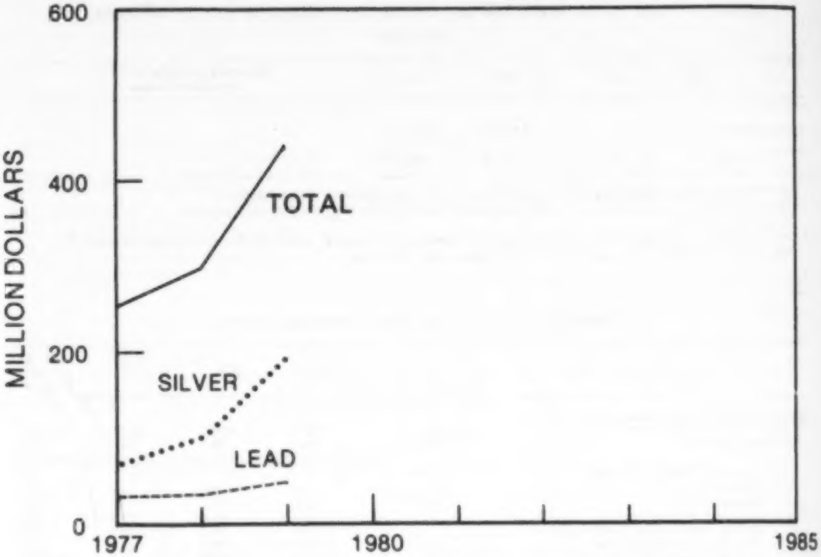

Figure 1.—Value of silver and lead, and total value of nonfuel mineral production in Idaho.

Trends and Developments.—In the Coeur d'Alene mining district, the State's largest producing area, most of the news involved corporate developments. An agreement between Hecla Mining Co. and Superior Oil Co., which would have solved Hecla's financial problems, fell through. In 1979, Rosario Resources Corp. purchased 16.7% of Hecla's stock from Narragansett Wire Co., a wholly owned subsidiary of El Paso Natural Gas Co. Rosario made the purchase for investment purposes; it now holds 19.94% of all outstanding Hecla shares. Late in 1979, Rosario and AMAX, Inc., announced an agreement whereby AMAX would acquire Rosario.

In October 1979, Hecla announced it would construct a new surface shaft at the Lucky Friday Mine. The shaft, costing nearly $26 million, will facilitate mining of ore below the 5,100-foot level. Groundbreaking for the new surface shaft is to begin in the first quarter of 1980; it should be completed in 1984. Hecla and Sunshine Mining Cos. reached an agreement that eliminated several longstanding operational conflicts in the Sunshine Unit Area, which is operated by the Sunshine Mine.

The previous 2 years (1978-79) saw corporate struggles in conjunction with the ownership of the Sunshine Mine. Hunt International Resource Corp. (HIRCO) was unable to complete its planned takeover of the Sunshine Mining Co. Sunshine's Board of Directors and the State of Idaho, under terms of its corporate takeover law, successfully blocked the Hunt offer and takeover. During March 1979, HIRCO sold its 28% interest in the Sunshine Mining Co. to a special holding company formed by the Board of Directors of Sunshine. This action resulted in the dismissal of all pending lawsuits by both sides in June. In early 1979, Sunshine's management also announced that it would move totally into the silver producing area, selling certain companies, including Anchor Post Products, Piezo Crystal Co., and Premier Metal Products. It sold its Idaho Garnet operation in Benewah County. Sunshine purchased J.R. Rayner, Ltd., a London-based silver trading company, and announced plans for a new silver refinery using a Sunshine-developed chemical-electrolytic technique to produce refined silver bullion.

Sunshine started sinking the No. 12 shaft in August 1979. The 1,100-foot shaft will connect the 3,700- and 4,800-foot levels, and provide Sunshine with deep mining access to known veins. By the end of 1979, the company estimated an ore reserve of 171.8 million ounces of silver valued at more than $1.5 billion.

An Idaho Supreme Court decision in October 1979, upheld Silver Syndicate's claim to 50% of the ore mined by Sunshine from three orebodies near the Chester vein. This decision ended longstanding disputes over control of deep orebodies in and around the Sunshine Unit Area which consists of claims controlled by Sunshine, Hecla, and Silver Dollar. Sunshine is engaged in similar litigation with Metropolitan Mines over the "copper vein" system.

The largest civil trial in Idaho's history was conducted in 1978. Families of miners who perished in the 1972 Sunshine Mine fire sued five chemical firms for $660 million. The plaintiffs alleged that underground use of polyurethane foam contributed to the fire. The suit was dismissed in the Federal courts. Later in 1978, the chemical companies paid $6 million to the miners' families in an out-of-court settlement.

During 1978, Bunker Hill celebrated the 50th anniversary of the opening of its electrolytic zinc plant in Kellogg. Also in 1978, the company constructed a new silver refinery and made plans to increase its capacity in 1979. Studies have shown that new emission stacks at the Bunker Hill smelter are improving air quality in the Silver Valley; however, the company remains in dispute with the Environmental Protection Agency (EPA) over new standards. The Bunker Hill smelter was shut down in January 1978, and again in January 1979, because sulphur dioxide emission standards were violated during periods of cold stagnant air. The Hunt brothers of Texas resumed action in the district in 1979. Through a subsidiary, Lake Placid Oil, they purchased 9.69% of Gulf Resources and Chemical Co. stock, the parent of Bunker Hill. Price increases in silver prompted the company to announce it would deepen the No. 2 shaft at the Crescent Mine to gain access to deeper ore zones. The Crescent Mine borders the Sunshine Mine in the Big Creek area.

High silver prices enabled ASARCO Inc. to retire, earlier than expected, its preproduction debt of more than $20 million on the Coeur Mine.

Exploration, with a diamond drilling program, continued on the Camp property (Coeur d' Alene Mines, Merger Mines, Plainview Mining) adjacent to the Coeur property.

In 1979, American Silver Mining Co. announced that a joint exploration venture with ASARCO and Coeur d'Alene Mines would start on the American Silver property in the Coeur d'Alene district. This property borders the Coeur Mine on the south.

Day Mines closed the Tamarack Mine in the last quarter of 1978 because of low zinc prices. The firm did not produce in 1979.

Many exploration and development projects were under way outside the Coeur d'Alene district. Canadian Superior Mining Co. started a pilot plant in 1978 to recover gold from a cyanide heap leach operation near Stibnite, Valley County. A gold-silver bar weighing 60 ounces was produced. Canadian Superior also acquired the Sunnyside Mine in the Thunder Mountain mining district near the Stibnite operation. Canadian Superior conducted further exploration in 1979, and continued to acquire permits in preparation of opening a small open pit gold mine at Stibnite.

Numerous companies, including Homestake Mining Co., ASARCO, AMAX, Texasgulf, Inc., and Houston Oil and Minerals Co., were actively exploring volcanic and related rocks in the Seven Devils area north and west of Cambridge in Adams County. Texasgulf purchased the Iron Dyke Mine on the Oregon side of Hells Canyon, and, in 1979, began shipping rock to Silver King's mill in Adams County. The company also purchased the Red Ledge Mine in Idaho for a reported $1.5 million.

Inspiration Development Co. was active in the Bayshore district, at the Salmon River Copper Mine west of Shoup in Lemhi County, and at the Ima Mine in the Blue Wing district of Lemhi County.

Exploration in 1978-79 was conducted by Bear Creek Mining Co. at Triumph Mine near Haley in Blaine County. In the Knapp Lake area of Custer County, near Stanley, Anaconda was exploring for molybdenum, while American Nickel and Copper Co. searched the area for uranium. Noranda Mines, Ltd., also explored for uranium on its Basin Creek Group in the same general vicinity.

Molybdenum exploration was being conducted by Cominco on the Napoleon Hill property near Leesburg in Lemhi County; Abella Mining Co. of Vancouver, B.C., Canada, was further evaluating a molybdenum-bearing zone (Little Falls Prospect) on the South Fork of the Payette River. A little farther south, AMAX continued drilling on the Cumo Prospect near Grimes Pass.

The dramatic price increase in gold caused an upsurge in dredge mining proposals and dredge mining applications in the latter part of 1977. Several small suction dredges were operated intermittently in streams around Elk City and other old gold camps in Idaho. Dredge mining permit applications to the State Board of Land Commissioners quadrupled in 1979 compared with 1978. Bear Valley Associates of Houston, Tex., applied for dredge mining and stream alteration permits for operations on Upper Bear Valley Creek, Valley County. The firm proposes to recover uranium, columbium, tantalum, and rare-earth oxides from patented placer claims.

High uranium oxide prices stimulated 1977 exploration that continued unabated through 1979. Several companies, including Minatome Corp., St. Joe American, Conoco, Pathfinder Mines, Rocky Mountain Energy Co., and Urania Exploration Co., were actively exploring in areas east and west of Priest Lake in northern Idaho. Several companies are exploring for uranium in the black shale of the Phi Kappa Formation east of Sun Valley in Blaine and Custer Counties. The Washington Public Power Supply System drilled claims near Cobalt and Ellis in Lemhi and Custer Counties and on its property near Gibbonsville.

The Iron Mask Mine at Talache, Bonner County, was in development during 1979, and shipped silver-bearing ore to the Cominco smelter at Trail, B.C., Canada. Sydney Mining Co. continued testing and geologic assessment of its 3,000-acre holding adjacent to the Delamar Mine in Owyhee County.

In the nonmetallic sector, phosphate production in southeastern Idaho continued at the same pace in 1978-79 as in previous years. In 1978, the U.S. Department of the Interior approved mining plans for two new phosphate open pits, the South Maybe Canyon Mine of Beker Industries and the North Trail Canyon Mine of J.R. Simplot. Beker Industries concluded a partnership agreement with Western Cooperative Fertilizer, Ltd., of Calgary, Alberta, Canada.

In 1979, Idaho Garnet Abrasive Co., a subsidiary of Sunshine Mining Co., was sold to the Emerald Creek Garnet Co. Both operations are mining garnet from placer deposits on Emerald Creek in Benewah County. All abrasive garnet now mined in Idaho will be marketed through Emerald Creek Garnet Co.

Legislation and Government Programs.—Federal actions or proposed actions that would affect the State's mineral sector during 1978-79 were:

1. Proposed replacement of the 1872 mining law by an all-leasing system.
2. U.S. Forest Service RARE II Wilderness study and inventory.
3. U.S. Bureau of Land Management (BLM) Wilderness studies under P.L. 94-579.
4. Proposed River of No Return Wilderness area.

In response to President Carter's proposal for a mineral leasing system, a new organization, Citizens for a Sound Mining Law, was formed in northern Idaho in 1978. Public hearings were held on the Forest Service RARE II study which could affect 8.2 million acres of the State. The final environmental impact statement on RARE II showed nearly 2.2 million acres proposed for addition to the Wilderness system. Most of this acreage surrounds the Idaho Primitive area or the proposed River of No Return Wilderness. Public hearings were also held throughout the State on the BLM planning process. These hearings indicated that of 12 million acres of BLM land, about 2.4 million acres could be classified as wilderness. Public hearings were also held in 1979 on the proposed River of No Return Wilderness area which could affect nearly 2.4 million acres of land in the central part of the State. Much of the controversy concerning this proposal was related to the cobalt area of Lemhi County, where the addition of wilderness peripheral to the Blackbird Mine could impinge upon the Nation's cobalt resources.

New constraints were imposed upon transportation of mineral products within the State. The Chicago, Milwaukee, St. Paul & Pacific Railroad, which filed for bankruptcy, discontinued all service in the State. Burlington Northern Inc. petitioned the Interstate Commerce Commission to allow abandonment of 39 miles of track connecting Wallace, Idaho, with Haugen, Mont. Ninety-seven percent of the freight on the Haugen-Wallace line is mineral products (ore concentrates, nonmetallic fertilizers, primary metals, etc.). Burlington Northern rail service between Wallace and Mullan would be transferred to the Union Pacific

Railroad.

New EPA lead standards, as proposed, have been criticized by the Bunker Hill Co. which operates the State's only smelter complex. It sees the standards as too stringent and economically unachievable. EPA is also seeking a penalty from Bunker Hill for excessive particulate pollution from the zinc fuming furnace.

U.S. Department of the Interior mineral resource agencies were active throughout the State in 1978-79. Mapping, both topographic and field, and hydrologic studies were conducted by the U.S. Geological Survey. Mineral appraisals were initiated in the Selway-Bitteroot Wilderness area and in southeastern Idaho. The U.S. Bureau of Mines initiated mineral appraisal studies in the Selway-Bitteroot Wilderness area and on BLM lands in southeastern Idaho. The Bureau was also appraising mineral resources of the Fort Hall Indian Reservation in southeasten Idaho. Alternate mining methods and the feasibility of recovering byproducts from phosphate rock operations were investigated by Bureau research centers. Extensive use was made of the Bureau's Mineral Industry Location System (MILS) and Minerals Availability System (MAS) in the RARE II and BLM Wilderness planning processes. The Bureau's research centers supported contracts for a field test on disposal of mill tailings in surface backfill, a program for destressing rock in advance of mining, and an evaluation and application of roadheaders in underground uranium mining.

By yearend 1979, under Title III of the Surface Mining Control and Reclamation Act of 1977 (P.L. 95-87), the Secretary of Interior had designated 31 schools and universities nationwide as State Mining and Mineral Resources and Research Institutes. The College of Mines and Earth Resources at the University of Idaho was designated as Idaho's Institute during 1978.

The 44th Idaho Legislature, second regular session, considered many new proposed laws for regulating the State's mineral industry in 1978. A new law was passed concerning design and construction of tailing ponds; the law requires the mineral operator to secure approval of the Idaho Department of Water Resources for tailing storage structures. Proposals to amend the Surface Mining and Dredge Mining Acts remained in committee or were vetoed by the Governor. A House Concurrent Resolution for amending Regulations 1 and 2 of the Mining License Tax died in committee.

The 45th Idaho Legislature, first regular session, met in 1979 and addressed relatively few mineral-related bills. One bill, House Concurrent Resolution 9, would have set royalties for mineral products from State lands to follow rules used by the Federal establishment. The bill died in committee. A pre-filed bill, one which was never introduced, would have called for reclaiming abandoned tailing ponds with funds for administration to be appropriated from the mine license tax payments.

The Idaho Bureau of Mines and Geology published a new State geologic map during 1978, and it conducted numerous geochemical and field geology studies, some under Federal contracts and grants. Several open-file reports were released during 1978-79. The Bureau of Minerals, Department of Lands, processed mineral lease applications for about 1,350 acres of State land during 1978, and more than 43,500 acres during 1979. Approximately 76,000 acres were under lease as of July 1, 1979. Approved active reclamation plans, as of July 1, 1979, totaled 526, covering approximately 20,000 acres. By the end of 1979 there were nine dredge mining permits approved covering 162 acres, with eight more permits pending.

For fiscal year 1978 (July 1, 1978 to June 30, 1979), State receipts for mineral royalties and rentals amounted to nearly $100,000. Total rentals and royalties paid the State (mineral, oil and gas, and geothermal) for the same period amounted to $1.1 million.

The Idaho State mine inspection program was terminated in 1979. Inadequate funding and duplication of services performed by the Federal Mine Safety and Health Administration were reasons for the elimination.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Antimony.—Antimony production and value increased in 1978 compared with that of 1977, but decreased in 1979. This decrease was because of production losses at the Sunshine Mine. Sunshine, the State's only producer, had underground transportation problems and was mining lower silver grade ores. Idaho ranked first in the Nation in antimony production for both years.

Cadmium.—Idaho's output of cadmium

came entirely from the Bunker Hill Co.'s zinc processing plant in Shoshone County. Production increased sharply in 1978 compared with that of 1977, but showed only a small increase in 1979.

Cobalt.—There was no recorded production of cobalt in the State; however, exploration and development by Noranda at the old Blackbird Mine in Lemhi County, continued. At the end of 1979, Noranda made a decision to place the mine into production. The Forest Service determined that an environmental impact statement must be completed for the project because of the relocation of the tailings disposal area.

Copper.—Tonnage and value of Idaho's mined copper increased in 1978 compared with that of 1977; however, production decreased in 1979 because of the tenor of the ore being mined in the Coeur d'Alene district. This district was the source of nearly 90% of the State's production; much of the remainder came from the Copper Cliff Mine in Adams County. At the end of 1978, a Salt Lake City firm announced the discovery of what may be a large copper deposit in Idaho County. The announcement precipitated a land-use classificaion controversy since the deposit borders the Hells Canyon Recreation Area on the Snake River.

Table 4.—Idaho: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Lode mines producing	Material sold or treated (metric tons)	Gold		Silver	
			Troy ounces	Value	Troy ounces	Value
1977, total	25	1,884,858	12,894	$1,912,308	15,291,964	$70,648,875
1978:						
Custer	6	71,258	27	5,227	97,600	527,040
Shoshone	11	1,440,916	2,891	559,553	16,309,864	88,073,263
Undistributed[1]	9	659,372	17,574	3,401,449	1,971,953	10,698,545
Total	26	2,171,546	20,492	3,966,229	18,379,417	99,248,848
1979:						
Custer	5	47,332	33	10,150	118,918	1,318,801
Kootenai	1	2,589	285	87,638	30,823	341,827
Shoshone	8	1,404,648	2,808	863,461	15,197,476	168,540,010
Undistributed[2]	20	666,843	21,014	6,461,808	1,796,992	19,928,641
Total	34	2,121,412	24,140	7,423,057	17,144,209	190,129,279

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1977, total	3,676	$5,413,405	42,872	$29,016,391	28,121	$21,326,529	$128,317,508
1978:							
Custer	14	20,887	328	243,459	262	179,077	975,690
Shoshone	3,349	4,910,282	44,430	33,009,978	32,089	21,930,876	148,483,952
Undistributed[1]	525	769,581	3	2,253	1	859	14,822,687
Total	3,888	5,700,750	44,761	33,255,690	[3]32,353	22,110,812	164,282,329
1979:							
Custer	17	34,103	233	269,982	79	65,126	1,698,162
Kootenai	6	11,846	5	5,619	--	--	446,930
Shoshone	3,231	6,625,803	42,299	49,089,164	29,569	24,315,324	249,433,762
Undistributed[2]	365	748,831	99	114,421	12	10,274	27,263,975
Total	[3]3,618	7,420,583	42,636	49,479,186	29,660	24,390,724	278,842,829

[1] Includes Adams, Blaine, Elmore, Kootenai, Lemhi, and Owyhee Counties combined to avoid disclosing company proprietary data.

[2] Includes Ada, Adams, Bannock, Bear Lake, Blaine, Boise, Bonner, Butte, Cassia, Elmore, Lemhi, Nez Perce, and Owyhee Counties combined to avoid disclosing company proprietary data.

[3] Data do not add to total shown because of independent rounding.

Table 5.—Idaho: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by class of ore or other source material

Source	Number of mines	Material sold or treated (thousand metric tons)	Gold (troy ounces)	Silver (thousand troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
1978							
Lode ore:							
Gold, gold-silver, and silver	15	1,302	19,724	16,316	3,062	15,652	1,993
Copper, lead, lead-zinc, and zinc[1]	11	870	768	2,063	826	29,109	30,359
Total lode material	26	2,172	20,492	18,379	3,888	44,761	[2]32,353
1979							
Lode ore:							
Gold, gold-silver, and silver[1]	13	1,330	23,510	15,445	2,996	17,908	2,141
Copper, lead, and lead-zinc[1]	21	791	630	1,700	622	24,728	27,519
Total lode material	34	2,121	24,140	[2]17,144	3,618	42,636	29,660

[1] Combined to avoid disclosing company proprietary data.
[2] Data may not add to totals shown because of independent rounding.

Table 6.—Idaho: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (thousand troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
1978					
Lode:					
Smelting of concentrates	2,921	16,443	3,885	44,732	32,350
Direct smelting of ore, amalgamation, and cyanidation[1]	17,571	1,937	4	29	3
Total[2]	20,492	18,379	3,888	44,761	32,353
1979					
Lode:					
Smelting of concentrates	2,840	15,339	3,609	42,519	29,641
Direct smelting of ore and cyanidation[1]	21,300	1,805	9	117	19
Total	24,140	17,144	3,618	42,636	29,660

[1] Combined to avoid disclosing company proprietary data.
[2] Data may not add to totals shown because of independent rounding.

Gold.—Production expansion in 1978-79 was largely a result of the increased capacity of Earth Resources' Delamar Mine in Owyhee County. A major price increase of the metal in the latter half of 1979 significantly enlarged the reserves at the Delamar. Gold production from the base metal deposits in the Coeur d'Alene region remained constant. Idaho ranked fifth in the Nation in gold production.

Lead.—Lead production declined in 1979 compared with that of 1978; lower grade ores were being mined in the Coeur d'Alene region. Most production came from the Bunker Hill and Hecla's Star and Lucky Friday units. The State ranked second in the Nation in newly mined lead for both years. Outside the Coeur d'Alene region, only the Clayton Silver Mine in Custer County had notable lead production. The State contained 33 producing lead mines in 1979.

Molybdenum.—There was no molybdenum production in the State either year; however, exploration expenditures rose to new highs. Cyprus Mines Corp. was completing initial studies in 1979 for the opening of the Thompson Creek Mine near Challis in Custer County. The company patented additional claims and began a comprehensive environmental impact statement for a mine-mill complex north of the Salmon River. There were also exploration projects elsewhere in Custer and Lemhi Counties. B and B Mining Co. continued an exploration adit at its Spring Creek deposit north of Salmon River near Shoup in Lemhi County. Exploration at the Ima Mine by Inspiration Development Co. continued to outline deposits of tungsten and molybdenum.

Silver.—Silver production in 1979 decreased compared with that of 1978, while value received nearly doubled. This was the result of the lower grade ores being mined in the Coeur d'Alene region in conjunction with the rapidly increased metal price. In 1979, The Galena Mine surpassed the Sunshine Mine as the Nation's top silver producer. The Sunshine, Galena, Lucky Friday, Coeur, and Delamar Mines each produced more than 2 million ounces. Idaho continued to be the Nation's largest silver producer, accounting for nearly 45% of newly mined metal.

Tungsten.—There was no tungsten production recorded in 1978-79. Exploration for the metal continued in Custer and Valley Counties; the largest exploration project was at the Ima Mine in Lemhi County.

Vanadium.—Production of vanadium from the Kerr-McGee plant at Soda Springs, Caribou County, Idaho, continued to decline throughout 1978-79. This was primarily because of the decrease in the quantity of ferro-phosphorus slag from the phosphate rock processing operation at Monsanto.

Zinc.—Production and value of zinc increased in 1978, compared with that of 1977. In 1979, production decreased compared with that of 1978, although there was a significant increase in value. The 1979 production decrease can be attributed to mining lower grade ores. Silver price increases during the latter half of 1979 more than offset the lower grade of zinc ore. Nearly 98% of Idaho's zinc production came from the Coeur d'Alene district; the only notable producer outside the district was the Clayton Silver Mine in Custer County.

NONMETALS

Abrasives (Natural).—Two Benewah County operations accounted for all State garnet production in 1978-79. The 1979 production fell to nearly one-half of that of 1978 because of changing market conditions. Sunshine Mining Co., owner of Idaho Garnet Abrasive Co., sold its entire garnet operation to a private individual in Benewah County.

Barite.—Rocky Mountain Refractories in Blaine County was the State's only 1978 barite producer; no barite was produced in 1979. NL Industries, Baroid Div., continued exploration and development of the Old Soldier barite deposit west of Hailey in Blaine County; production schedules call for shipments from this deposit in early 1982.

Cement.—Cement production from the Idaho Portland Cement Co. at Inkom in Bannock County remained constant in 1978-79. There was a slight increase in the quantity of masonry cement produced.

Clays.—Clay production remained constant both years. The largest producer in 1978 was the J. R. Simplot Co. from its pits in Latah County. The company has continued research on reclamation techniques in and around operations at Bovill.

Gem Stones.—Opals (Clark County), star garnets (Benewah County), fire opals, and jasperoid (Owyhee County) were the most sought-after gems in the State. During the preceding 2 years, markets have developed in the East for "Owyhee picture rock," the gem-quality jasperoid found mostly in Owyhee County.

Lime.—Production of lime decreased dramatically throughout 1978-79 because of falloff of the sugar beet processing industry in southern Idaho.

Perlite.—Oneida Perlite, Oneida County, continued to be the State's only producer. Production and value increased in 1978 and again in 1979. Nearly one-half of the total perlite production for making expanded perlite was shipped to Oneida's plant at Malad City.

Phosphate Rock.—Total marketable production of phosphate rock increased in both 1978 and 1979; value also increased substantially in 1979. Five mines were in operation in 1978, with six producers in 1979; Alumet's Lane Creek Mine was the new producer. Phosphate ore reduction was split almost evenly between elemental phosphorus and wet-process phosphoric acid. Late in 1979, Idaho Power requested a nearly 50% increase in the electrical utility rates to FMC's phosphoric acid plant. This increase may have an effect on the feasibility of continued elemental phosphorus production in the State. J. R. Simplot Co. continued exploration on phosphate leases in Caribou County.

Pumice.—Pumiceous material production decreased nearly 35% in 1979 compared with that in 1978; value received dropped a corresponding amount. Amcor, Inc., Bonneville County, was the State's leading producer; its entire output was consumed in concrete aggregate. Material was also produced in Bingham and Oneida Counties.

Sand and Gravel.—Production and value of sand and gravel increased somewhat in 1978-79 as a result of increased economic activity throughout the State. Ada, Canyon, and Bonneville Counties continued to have the greatest production.

Table 7.—Idaho: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	2,208	$5,309	$2.40	2,681	$6,728	$2.51	2,402	$6,255	$2.60
Plaster and gunite sands	NA	NA	NA	W	57	W	21	W	W
Concrete products	172	466	2.71	181	479	2.65	180	479	2.66
Asphaltic concrete	1,156	3,015	2.61	998	3,101	3.11	755	2,246	2.98
Roadbase and coverings	3,224	5,265	1.63	3,069	5,717	1.86	3,497	7,476	2.14
Fill	940	1,140	1.21	948	1,408	1.48	579	941	1.62
Snow and ice control	NA	NA	NA	W	120	W	W	49	W
Railroad ballast	--	--	--	--	--	--	183	429	2.35
Other uses	49	89	1.80	27	68	2.51	100	274	3.03
Total[1] or average	7,750	15,282	1.97	7,975	17,680	2.22	7,719	18,149	2.35

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."
[1] Data may not add to totals shown because of independent rounding.

Table 8.—Idaho: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	1,926	$3,887	$2.02	2,395	$5,748	$2.40	2,029	$4,931	$2.43
Gravel	5,824	11,395	1.96	5,580	11,930	2.14	5,690	13,218	2.32
Total or average	7,750	15,282	1.97	7,975	17,680	2.22	7,719	18,149	2.35
Industrial sand	W	W	W	137	1,617	11.78	W	W	W
Grand total[1] or average	W	W	W	8,112	19,290	2.38	W	W	W

W Withheld to avoid disclosing company proprietary data.
[1] Data may not add to totals shown because of independent rounding.

Stone.—Roadstone and riprap continued to be the largest uses of crushed stone. Government agencies, the U.S. Forest Service, the Idaho State Highway Department, and the U.S. Army Corps of Engineers continued to be the largest producers. Limestone was used as flux rock by the Monsanto Co. and by Kerr-McGee for its vanadium processing plant in Caribou County.

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[1] State mineral specialist, Bureau of Mines, Spokane, Wash.

[2] Associate director, Idaho Bureau of Mines and Geology, Moscow, Idaho.

Table 9.—Idaho: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Poultry grit and mineral food	W	16	5	15	5	16
Concrete aggregate	218	434	W	W	--	--
Bituminous aggregate	W	W	72	238	W	W
Dense-graded roadbase stone	143	346	W	W	122	324
Surface treatment aggregate	303	635	475	1,044	795	1,593
Other construction aggregate and roadstone	678	1,458	889	1,989	844	2,230
Riprap and jetty stone	618	1,457	519	1,038	369	796
Flux stone	725	3,041	W	W	W	W
Chemicals	W	62	26	78	31	93
Paper manufacture	29	79	30	68	50	117
Other uses[2]	363	483	607	2,200	736	3,620
Total[3]	3,077	8,005	2,624	6,670	2,952	8,787

W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Includes limestone, granite, sandstone, traprock, and miscellaneous stone (1977-78).

[2] Includes cement manufacture, macadam aggregate (1977-78), abrasives (1977), and roofing granules.

[3] Data may not add to totals shown because of independent rounding.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
METALS			
Antimony:			
Sunshine Mining Co	Box 1080 Kellogg, ID 83837	Mine, mill, plant	Shoshone.
Copper:			
ASARCO Inc	Box 440 Wallace, ID 83873	Mine and mill	Do.
Silver King Mines	1204 Deseret Bldg. Salt Lake City, UT 84111	Surface mine and mill.	Adams.
Sunshine Mining Co	Box 1080 Kellogg, ID 83837	Mine and mill	Shoshone.
The Bunker Hill Co	Box 29 Kellogg, ID 83837	Mine, mill, plant	Do.
Gold:			
Earth Resources	Box 52 Jordan Valley, OR 97910	Surface mine and mill.	Owyhee.
Hecla Mining Co	Box 320 Wallace, ID 83873	Mine and mill	Shoshone.
Lead:			
Hecla Mining Co	Box 320 Wallace, ID 83873	do	Do.
The Bunker Hill Co	Box 29 Kellogg, ID 83837	Mine, mill, plant	Do.
Day Mines, Inc	Box 1010 Wallace, ID 83873	Mine	Do.
Clayton Silver Mines	Box 890 Wallace, ID 83873	Mine and mill	Custer.
Silver:			
ASARCO Inc	Box 440 Wallace, ID 83873	do	Shoshone.
Hecla Mining Co	Box 320 Wallace, ID 83873	do	Do.
Sunshine Mining Co	Box 1080 Kellogg, ID 83837	do	Do.
Earth Resources	Box 52 Jordan Valley, OR 97910	Surface mine and mill.	Owyhee.
Clayton Silver Mines	Box 890 Wallace, ID 83873	Mine and mill	Custer.
The Bunker Hill Co	Box 29 Kellogg, ID 83837	Mine, mill, plant	Shoshone.
Silver King Mines	1204 Deseret Bldg. Salt Lake City, UT 84111	Mine and mill	Adams.
Vanadium:			
Kerr-McGee Corp	Box 478 Soda Springs, ID 83276	Plant	Caribou.
Zinc:			
The Bunker Hill Co	Box 29 Kellogg, ID 83837	Mine, mill, plant	Shoshone.
Hecla Mining Co	Box 320 Wallace, ID 83873	Mine and mill	Do.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
METALS —Continued			
Zinc —Continued			
Day Mines, Inc	Box 1010 Wallace, ID 83873	Mine	Shoshone.
Clayton Silver Mines	Box 890 Wallace, ID 83873	Mine and mill	Custer.
NONMETALS			
Abrasives:			
Idaho Garnet Abrasive Co	Box 1080 Kellogg, ID 83837	Placer mine and plant.	Benewah.
Emerald Creek Garnet	Box 176 Fernwood, ID 83830	Placer mine	Do.
Barite:			
Rocky Mountain Refractories	2436 West Andrew Ave. Salt Lake City, UT 84104	Mine	Blaine.
Cement:			
Idaho Portland Cement Co	Old National Bank, Rm. 622 Inkom, ID 83245	Surface mine and plant.	Bannock.
Clays:			
Interpace Corp	Box 785 Ione, CA 95640	Surface mine	Benewah.
J. R. Simplot Co.	Box 912 Pocatello, ID 83201	do	Latah.
Pullman Brick Co	5657 Warm Springs Ave. Boise, ID 83706	Surface mine and plant.	Elmore.
A. P. Green Refractories	Box 158 Troy, ID 83871	do	Latah.
Gypsum:			
E. J. Wilson & Sons	Dubois, ID 83423	Surface mine	Lemhi.
Consumers Coop Association	502 Pioneer Rd. Wieser, ID 83672	do	Washington.
Lime:			
Utah & Idaho Sugar Co	Box 1855 Idaho Falls, ID 83410	Plant	Bonneville.
Amalgamated Sugar Co	First Security Bank Bldg. Ogden, UT 84402	do	Various.
Perlite:			
Oneida Perlite Co	Box 162 Malad City, ID 83252	Surface mine and plant.	Oneida.
Phosphate rock:			
Conda Partnership	Box 37 Conda, ID 83230	do	Caribou.
J. R. Simplot Co.	Box 912 Pocatello, ID 83201	do	Various.
FMC Corp	1356 North Main Pocatello, ID 83201	Plant	Power.
Stauffer Chemical Co	Star Route Randolph, UT 84064	Surface mine	Caribou.
Monsanto Co	800 North Lindbergh St. Louis, MO 63166	do	Do.
Pumice:			
Amcor, Inc.	Box 1141 Idaho Falls, ID 83401	Quarry	Bonneville.
Producers Pumice	6001 Fairview Ave. Boise, ID 83704	do	Do.
Hess Pumice Products	Box 209 Malad City, ID 83252	do	Oneida.
Sand and gravel:			
MONROC	Box 1221 Idaho Falls, ID 83401	Pit	Various.
Idaho Concrete Pipe Co	222 Caldwell Blvd. Nampa, ID 83651	Pit	Do.
Stone:			
U.S. Forest Service, Region 4	U.S. Federal Bldg. Ogden, UT 84403	Quarry	Do.
Idaho Department of Transportation	Box D Coeur d'Alene, ID 83814	do	Do.
Idaho Portland Cement Co	Old National Bank, Rm. 622 Inkom, ID 83245	Quarry and plant	Bannock.
Deatley Corp	Box 648 Lewiston, ID 83501	Quarry	Various.
Monsanto Co	800 North Lindbergh Blvd. St. Louis, MO 63166	do	Caribou.

The Mineral Industry of Illinois

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Illinois State Geological Survey for collecting information on all nonfuel minerals.

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The value of Illinois' nonfuel mineral production was $440 million in 1978 and $477 million in 1979. During these years, portland cement, sand and gravel, and stone accounted for most of the State's total nonfuel mineral production value. Other commodities produced were clays, fluorspar, lime, masonry cement, and tripoli. Barite, lead, silver, and zinc were recovered as coproducts from fluorspar processing operations. Major commodities imported for processing included gypsum, crude iron oxide pigments, perlite, and vermiculite. In 1979, silicon carbide, an artificial abrasive, was produced in Illinois for the first time.

Table 1.—Nonfuel mineral production in Illinois[1]

Mineral	1977 Quantity	1977 Value (thousands)	1978 Quantity	1978 Value (thousands)	1979 Quantity	1979 Value (thousands)
Cement, portland thousand short tons	1,823	$61,849	2,112	$80,242	1,889	$79,604
Clays[2] do	951	5,117	742	3,185	542	2,355
Fluorspar short tons	131,218	13,941	115,859	12,452	W	W
Gem stones	NA	2	NA	15	NA	15
Peat thousand short tons	82	1,478	84	1,594	86	1,610
Sand and gravel do	37,633	101,230	43,450	127,900	45,448	134,190
Stone:						
Crushed do	57,074	135,964	62,453	160,352	63,551	188,130
Dimension do	3	109	3	122	3	128
Combined value of barite, cement (masonry), clays (fuller's earth), lead, lime, silver, tripoli, zinc, and values indicated by symbol W	XX	48,641	XX	53,692	XX	70,498
Total	XX	368,331	XX	439,554	XX	476,530

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fuller's earth; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Illinois, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Adams	W	W	Stone, sand and gravel.
Alexander	W	W	Tripoli, sand and gravel.
Bond	$660	$639	Sand and gravel, clays.
Boone	W	W	Stone, sand and gravel.
Brown	W	W	Stone, clays.
Bureau	777	1,172	Sand and gravel.
Calhoun	W	W	Stone.
Carroll	410	759	Do.
Champaign	1,203	1,649	Sand and gravel.
Christian	1,290	1,500	Stone.
Clark	2,915	W	Stone, sand and gravel.
Clay	W	W	Stone.
Clinton	W	W	Stone, sand and gravel.
Coles	W	W	Do.
Cook	69,724	W	Lime, stone, sand and gravel, clays, peat.
Crawford	W	--	
Cumberland	W	559	Sand and gravel.
De Kalb	W	W	Stone, sand and gravel.
Douglas	1,592	W	Stone.
Du Page	W	W	Sand and gravel, stone.
Effingham	W	W	Sand and gravel.
Fayette	W	W	Stone, sand and gravel, clays.
Ford	W	1,061	Sand and gravel.
Fulton	749	W	Do.
Gallatin	W	W	Do.
Greene	W	893	Stone.
Grundy	W	W	Sand and gravel, clays.
Hancock	761	W	Stone, sand and gravel.
Hardin	21,690	W	Fluorspar, stone, zinc, lead, barite, silver.
Henderson	1,043	1,170	Stone.
Henry	W	W	Do.
Iroquois	W	W	Do.
Jackson	W	W	Stone, sand and gravel.
Jersey	132	302	Do.
Jo Daviess	W	W	Sand and gravel, stone.
Johnson	W	W	Stone.
Kane	12,152	17,714	Sand and gravel, stone.
Kankakee	W	W	Stone, clays, sand and gravel.
Kendall	W	W	Sand and gravel, stone.
Lake	W	W	Sand and gravel, stone, peat.
La Salle	W	W	Sand and gravel, cement, stone, clays.
Lawrence	1,154	1,542	Sand and gravel, stone.
Lee	W	W	Cement, stone.
Livingston	8,730	7,562	Stone, clays.
Logan	W	W	Stone, sand and gravel.
McDonough	W	W	Stone, clays.
McHenry	14,049	18,308	Sand and gravel.
McLean	2,101	1,875	Do.
Macon	1,575	2,027	Do.
Madison	3,968	4,845	Stone, sand and gravel.
Marion	W	W	Stone.
Marshall	W	W	Sand and gravel.
Mason	W	35	Do.
Massac	W	W	Cement, sand and gravel.
Menard	W	2,191	Stone.
Mercer	26	--	
Monroe	W	W	Stone.
Montgomery	4,302	5,017	Do.
Moultrie	W	W	Sand and gravel.
Ogle	1,963	W	Sand and gravel, stone.
Peoria	2,280	2,090	Do.
Perry	102	--	
Piatt	W	W	Sand and gravel.
Pike	W	W	Stone, sand and gravel.
Pulaski	W	W	Clays, stone, sand and gravel.
Putnam	W	W	Sand and gravel.
Randolph	W	W	Stone, sand and gravel.
Rock Island	W	W	Do.
St. Clair	W	W	Do.
Saline	--	W	Stone.
Sangamon	2,372	3,372	Sand and gravel.
Schuyler	W	W	Do.
Scott	W	W	Stone.
Shelby	W	W	Sand and gravel, stone.
Stark	W	--	
Stephenson	683	1,276	Stone, sand and gravel.
Tazewell	2,615	W	Sand and gravel, clays.
Union	W	W	Stone, sand and gravel.
Vermilion	W	W	Do.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Illinois, by county[1] —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Wabash	$212	$290	Sand and gravel.
Warren	1,683	2,476	Stone.
Washington	W	W	Do.
White	597	W	Sand and gravel.
Whiteside	W	W	Peat, stone, sand and gravel.
Will	14,362	16,761	Stone, sand and gravel.
Williamson	151	---	
Winnebago	3,178	3,102	Sand and gravel, stone.
Woodford	2,566	2,810	Sand and gravel.
Undistributed[2]	184,567	336,568	
Total[3]	368,331	439,554	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Cass, De Witt, Edgar, Edwards, Franklin, Hamilton, Jasper, Jefferson, Knox, Macoupin, Morgan, Pope, Richland, and Wayne Counties are not listed because no nonfuel mineral production was reported.

[2] Includes stone that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Illinois business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	5,206.0	5,324.0	5,332.0	+0.2
Unemployment	do	320.0	323.0	293.0	-9.3
Employment (nonagricultural):					
Mining[1]	do	29.0	26.6	30.4	+14.3
Manufacturing	do	1,192.9	1,238.9	1,261.6	+1.8
Contract construction	do	175.2	185.8	181.8	-2.2
Transportation and public utilities	do	274.7	282.0	329.9	+17.0
Wholesale and retail trade	do	1,048.2	1,088.3	1,101.9	+1.2
Finance, insurance, real estate	do	266.5	280.9	275.7	+5.3
Services	do	829.9	859.4	900.0	+4.7
Government	do	717.8	728.0	758.2	+4.1
Total nonagricultural employment[1]	do	4,534.3	4,689.9	4,859.3	+3.6
Personal income:					
Total	millions	$90,265.0	$99,716.0	$110,302.0	+10.6
Per capita		$8,039.0	$8,870.0	$9,823.0	+10.7
Construction activity:					
Number of private and public residential units authorized		75,374.0	[2]72,163.0	45,644.0	-36.7
Value of nonresidential construction	millions	$1,087.6	$1,385.9	$1,634.5	+17.9
Value of State road contract awards	do	$330.0	$585.0	$625.0	+6.8
Shipments of portland and masonry cement to and within the State	thousand short tons	3,755.0	3,808.0	3,511.0	-7.8
Nonfuel mineral production value:					
Total crude mineral value	millions	$368.3	$439.6	$476.5	+8.4
Value per capita, resident population		$33	$39	$42	+7.7
Value per square mile		$6,531	$7,794	$8,449	+8.4

[p] Preliminary.

[1] Includes bituminous coal and oil and gas extraction.

[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Legislation and Government Programs.—During the 1978 and 1979 legislative sessions, several Illinois Senate and House bills related to mining were enacted into law. Some of these laws are briefly described below.

SB-1861—Created the Illinois Institute of Natural Resources, which combined several existing agencies into one organization. Agencies included in the new institute were the State's Geological Survey, Natural History Survey, and Water Survey; the Illinois State Museum; Division of Energy; and the Institute for Environmental Quality.

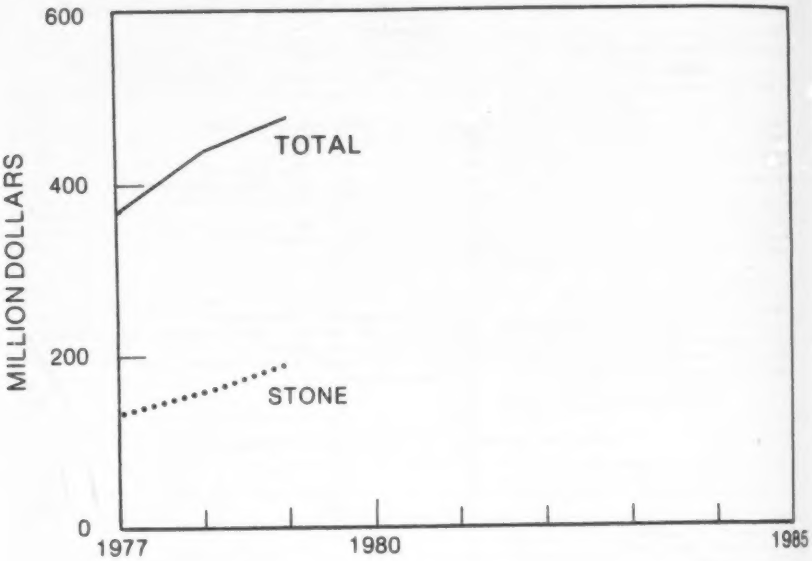

Figure 1.—Value of stone and total value of nonfuel mineral production in Illinois.

HB-2912—Amended the Surface-Mined Land Conservation and Reclamation Act of 1971 to allow the State to participate in enforcing the interim regulations of the Federal Surface Mining Control and Reclamation Act of 1977.

HB-157—Required a study of underground mining practices, subsidence problems, and available technology for combating subsidence and required that a report be submitted to the legislature with recommendations for the protection of Illinois homeowners.

HB-158—Provided subsidence insurance to Illinois residents against the effects of underground coal, clay, limestone, and fluorspar mines.

HB-0518—Amended the Surface-Mined Land Conservation and Reclamation Act to extend the life of the Aggregates Mining Problems Study Commission until 1983.

HB-1382—Provided funding for the State's Mine Subsidence Insurance Fund.

Also during the 1978-79 period, other laws were enacted to bring the State into compliance with the Federal Surface Mining Control and Reclamation Act of 1977.

In late 1978, Southern Illinois University at Carbondale was designated as a State Mining and Mineral Resources and Research Institute by the Secretary of the Interior. Southern Illinois was one of 31 schools and universities in the United States that was planning to establish training programs in mining and minerals extraction. Annual allotments were provided to the University through fiscal year 1984 under the auspices of the Surface Mining Control and Reclamation Act of 1977. Initially, the Institute received a basic grant of $110,000 and $160,000 for scholarships and fellowships.

In 1978 and 1979, the Illinois Geological Survey continued research programs in basic geology, geochemistry, mineral resources, mineral economics, and the environment. Clays and shales were investigated to determine their occurrence, composition, and ceramic properties. High-purity limestone and dolomite sources were evaluated through subsurface, trace-element, and petrographic studies. Economic, geologic, and environmental factors related to underground mining of limestone resources were examined. Sand and gravel and peat resources were mapped, and studies continued on the fluorspar district of southern Illinois.

In 1977, the Forest Service of the U.S. Department of Agriculture initiated its Roadless Area Review and Evaluation (RARE II) program. The program identified roadless and undeveloped land areas in the National Forest System that were suitable for wilderness use. In 1979, nine areas in the Shawnee National Forest were evaluated and four areas (totaling 16,563 acres) were nominated for wilderness status. Two of the areas (totaling 10,395 acres) were expected to be the subject of further planning. Congressional action on the areas selected for wilderness was expected in the near future.

The Bureau of Land Management began a program to develop maps (1:100,000 scale) of the surface and mineral estate on lands owned by the Federal Government, to aid in their management. In Illinois, four quadrangle maps (Cape Girardeau, Carbondale, Paducah, and West Frankfort) had been released by 1979.

The Federal Bureau of Mines had 18 contracts and grants completed with State universities and private industry that were active or had been completed during fiscal 1978 and 1979; they totaled approximately $2.9 million. Sponsored projects involved minerals availability, environmental research, metal and nonmetal mining technology, and mine health and safety.

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NONMETALS

Abrasives.—Tripoli was extracted from underground mines in Alexander County by Illinois Minerals Co. and Tammsco, Inc. Principal uses were as abrasives and for filler.

Silicon carbide, an artificial abrasive, was produced by ESK Corp. in Putnam County, a subsidiary of Wacker Chemical Co. Located near Hennepin, the plant opened in 1978 with a yearly capacity of 25,000 short tons. The product was used as an abrasive, as a refractory material, and in metallurgical applications.

Barite.—Allied Chemical Corp. was the State's only producer of primary barite in 1978 and 1979. Barite was recovered as an accessory mineral from fluorspar mining operations at the Minerva mine in Hardin County. Barite was used as an essential additive in drilling muds by the oil and gas industry. Drilling mud acts as a lubricant, drill bit cooling medium, wall-caving retardant, and preventative against blowouts.

Cement.—The State's portland cement shipments to consumers during the 1970's peaked in 1978 at about 2.1 million short tons per year. A decline occurred in 1979, but shipments still remained above the 1.8-million-ton level.

Illinois Cement Co., Inc., Marquette Co., and Medusa Corp. produced cement in the northern part of the State in adjoining La Salle and Lee Counties. The only operator in southern Illinois was Missouri Portland Cement Co. in Massac County. Of all the cement sold in the State, 97% was type I and II (general use and moderate heat). Ready-mix companies, concrete product manufacturers, highway contractors, and building materials dealers were the primary consumers. Raw materials used in the manufacture of cement included limestone, shale, fly ash, and gypsum. Modes of cement transportation included rail, truck, and barge.

Table 4.—Illinois: Portland cement salient statistics

(Short tons)

	1978	1979
Number of active plants	4	4
Production	2,122,587	1,998,317
Shipments from mills:		
Quantity	2,112,477	1,888,594
Value	$80,242,233	$79,603,714
Stocks at mills, Dec. 31	125,638	228,132

Clays.—In 1979, clay was produced in Illinois by 15 companies at 19 mines and pits. Leading producers were American Brick Co., Cook County; and Streator Brick Systems, Inc., La Salle and Livingston Counties. In 1978, Ristokrat Clay Products Co. and General Dynamics Corp. both terminated operations in La Salle County. Primary uses of common clay were for the manufacture of face brick, common brick, sewer pipe, portland cement, and drain tile.

The State's output of drain tile declined in 1978 and 1979 because of increased use of plastic pipe.

Illinois ranked fourth in production among the nine States that produced fuller's earth in 1979. The material absorbs more water than common clay and was used in oil refining for decolorizing and purifying purposes.

Fluorspar.—Although Illinois continued to be the Nation's leading producer, shipments in 1978 and 1979 were the lowest of the decade, except for those of 1975. The decline was attributed to market conditions and foreign imports.

Fluorspar was mined in Hardin County by the Hastie Mining Co., Ozark-Mahoning Co., and Allied Chemical Corp. At yearend 1979, Allied ceased operations pending sale of the company's fluorspar holdings.

During the 1978-79 period, Ozark-Mahoning operated the Barnett, Oxford No. 7, Knight, and H. M. mines. The company began sinking the Henson shaft, developed a new vein through a crosscut from the Barnett mine, and completed the Denton shaft. Fluorspar was used by the chemical, glass, ceramic, and steel industries.

Gem Stones.—Small quantities of mineral specimens were collected in the southern Illinois fluorspar district by hobbyists and members of lapidary clubs.

Gypsum.—National Gypsum Co. imported crude gypsum from Michigan and Canada in 1978 and 1979. The material was calcined at the company's Waukegan plant in Lake County for use in wallboard.

Lime.—Both quicklime and hydrated lime were produced by Marblehead Lime Co. at two plants in Cook County. In 1979, Marblehead began construction of a 1,450-short-ton-per-day kiln at its South Chicago plant. Vulcan Materials Co., also in Cook County, produced quicklime. Major uses of lime were in steelmaking, refractories, water purification, and sewage treatment.

Peat.—Illinois ranked third in the United States in peat production, contributing about 10% of the national total in 1978 and 1979. After processing by drying, shredding, and screening, the peat was used almost exclusively in agricultural and horticultural applications. Transportation (by truck) added significantly to the cost of peat because of its bulk.

Perlite.—Illinois led the Nation in the quantity of expanded perlite produced in 1979. Crude perlite mined outside the State was processed by five companies in Cook, De Kalb, Lake, and Will Counties. Uses were for insulation, horticultural purposes, as construction aggregate, and as a filter aid.

Sand and Gravel.—Nationally the State ranked sixth in output in 1978 and again in 1979. In terms of value, sand and gravel continued to be the second leading nonfuel commodity mined in Illinois. In 1979, production was from 62 of the State's 102 counties at over 200 locations.

Most of the construction sand and gravel that was mined was used for aggregate, roadbase, and fill. Industrial-quality sand was used mainly for glass manufacturing and for foundry molding and core.

Table 5.—Illinois: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	13,223	$30,588	$2.31	15,395	$37,650	$2.45	16,393	$37,429	$2.28
Plaster and gunite sands	NA	NA	NA	W	W	W	47	150	3.16
Concrete products	1,867	5,083	2.72	1,615	4,621	2.86	1,705	4,454	2.61
Asphaltic concrete	5,677	11,366	2.00	5,583	12,809	2.29	5,967	13,005	2.18
Roadbase and coverings	7,113	13,586	1.91	9,244	19,270	2.08	10,048	22,143	2.20
Fill	4,975	6,827	1.37	5,341	8,078	1.51	5,403	8,710	1.61
Snow and ice control	NA	NA	NA	132	261	1.98	116	223	1.93
Railroad ballast	38	91	2.36	1	2	2.29	1	3	3.21
Other uses	394	812	2.06	346	984	2.84	353	899	2.54
Total[1] or average	33,286	68,353	2.05	37,660	83,680	2.22	40,033	87,016	2.17

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Data may not add to totals shown because of independent rounding.

Table 6.—Illinois: Sand and gravel sold or used by producers, by use

Use	1977 Quantity (thousand short tons)	1977 Value (thousands)	1977 Value per ton	1978 Quantity (thousand short tons)	1978 Value (thousands)	1978 Value per ton	1979 Quantity (thousand short tons)	1979 Value (thousands)	1979 Value per ton
Construction:									
Sand	16,628	$31,000	$1.86	17,652	$35,290	$2.00	18,222	$35,355	$1.94
Gravel	16,658	37,353	2.24	20,005	48,386	2.42	21,810	51,661	2.37
Total[1] or average	33,286	68,353	2.05	37,660	83,680	2.22	40,033	87,016	2.17
Industrial:									
Sand	W	W	W	5,790	44,240	7.64	5,416	47,174	8.71
Gravel	W	W	W	--	--	--	--	--	--
Total	4,347	32,878	7.56	5,790	44,240	7.64	5,416	47,174	8.71
Grand total[1] or average	37,633	101,230	2.69	43,450	127,900	2.94	45,448	134,190	2.95

W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Table 7.—Illinois: Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1977 Quantity	1977 Value	1978 Quantity	1978 Value	1979 Quantity	1979 Value
Bond	263	521	216	486	445	915
Boone	257	458	W	396	W	419
Bureau	315	777	500	1,172	546	1,269
Champaign	581	1,203	708	1,649	620	1,563
Clark	496	1,075	411	1,016	391	992
Clay	103	216	--	--	--	--
Cook	W	W	751	1,840	1,436	3,199
Crawford	W	W	--	--	W	W
Cumberland	W	W	242	559	234	542
De Kalb	216	447	251	584	142	387
De Witt	--	--	--	--	77	262
Du Page	1,200	3,032	1,200	3,032	1,200	3,032
Fayette	50	75	50	75	128	187
Ford	W	W	420	1,061	333	940
Fulton	381	747	W	W	242	W
Hancock	--	--	W	W	W	W
Henderson	--	--	--	--	W	W
Jackson	--	--	W	W	--	--
Kane	4,589	9,504	6,320	14,000	6,039	12,621
Kankakee	26	31	23	35	15	17
Kendall	116	160	463	900	390	633
Lake	1,301	1,851	1,443	2,345	1,723	2,379
La Salle	4,806	33,619	5,496	40,055	5,504	43,896
Lawrence	700	1,154	682	1,444	W	W
Logan	611	1,263	377	788	261	568
McHenry	7,048	14,049	8,337	18,308	9,144	19,238
McLean	753	2,101	670	1,875	960	2,918
Macon	772	1,573	W	2,027	W	2,027
Madison	478	896	589	1,242	565	1,019
Marion	--	--	--	--	W	W
Mason	W	W	22	35	17	28
Massac	15	W	W	92	W	W
Ogle	--	--	W	W	W	W
Peoria	829	1,563	670	1,281	587	1,166
Piatt	W	W	W	W	W	319
Pulaski	15	23	14	27	W	W
Sangamon	985	2,372	1,056	3,372	1,079	2,896
Shelby	W	505	W	486	W	639
Stark	W	W	--	--	--	--
Stephenson	67	165	70	188	69	173
Tazewell	1,031	2,555	1,004	2,605	1,109	3,105
Union	13	19	1	1	10	W
Vermilion	170	261	149	239	175	292
Wabash	103	212	144	290	144	301
White	305	597	W	W	W	W
Whiteside	186	440	W	664	288	610
Will	1,561	3,494	1,960	4,620	1,752	4,208
Winnebago	850	1,491	921	1,603	908	1,568

See footnotes at end of table.

Table 7.—Illinois: Sand and gravel sold or used by producers, by county —Continued

(Thousand short tons and thousand dollars)

County	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Woodford	951	2,566	1,024	2,810	1,269	3,573
Undistributed[1]	5,491	10,219	7,264	14,711	7,628	16,295
Total[2]	37,633	101,230	43,450	127,900	45,448	134,190

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes Adams, Alexander, Clinton, Coles, Effingham, Gallatin, Grundy, Jo Daviess, Marshall, Moultrie, Pike, Putnam, Randolph, Rock Island, St. Clair, and Schuyler Counties, and data indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Slag (Iron and Steel).—Illinois continued to be one of the Nation's leading slag producers, ranking fifth in 1979. Two companies produced air-cooled blast furnace slag, and four companies produced steel slag. Primary use was for construction aggregate.

Stone.—Nationally, Illinois ranked third in stone production in 1978 and fourth in 1979. Limestone was the only type of stone mined. Production in the State averaged about 61 million short tons per year during the 1970's.

In 1979, crushed stone was extracted in 58 counties at 202 sites. Eleven operations each produced over 900,000 tons, and accounted for about 46% of the State's production total. Leading counties, in decreasing order of tonnage, were Cook, Will, Hardin, St. Clair, and La Salle. Two new quarries were opened, one in Jackson County by Kincaid Stone Co. and the other in Kendall County by Avery Gravel Co.

A minor amount of limestone was extracted for use as dimension stone by the Fox River Stone Co. in Kane County. The stone was used as rubble, flagging, and as house veneer.

Table 8.—Illinois: Crushed limestone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	4,337	11,233	4,844	13,530	5,241	16,445
Poultry grit and mineral food	141	1,146	223	1,601	160	1,465
Concrete aggregate	9,384	21,999	8,962	22,730	8,720	26,222
Bituminous aggregate	5,571	13,012	6,651	15,838	7,240	21,236
Macadam aggregate	2,836	6,336	2,789	6,323	2,714	7,953
Dense-graded roadbase stone	14,651	34,103	16,920	43,289	19,909	57,471
Surface treatment aggregate	4,030	9,122	4,168	9,852	4,447	13,071
Other construction aggregate and roadstone	9,429	20,640	10,630	26,097	7,824	20,264
Riprap and jetty stone	542	1,259	600	1,584	534	1,583
Railroad ballast	640	1,358	800	1,675	509	1,411
Filter stone	37	103	W	W	28	89
Manufactured fine aggregate (stone sand)	77	173	51	146	33	107
Cement manufacture	3,065	5,510	3,189	6,191	3,280	6,836
Flux stone	W	W	W	W	862	2,547
Asphalt filler	83	345	104	506	105	446
Whiting or whiting substitute	26	150	W	W	--	--
Other fillers or extenders	655	5,972	644	6,123	668	7,334
Roofing granules	W	2	W	W	--	--
Sulfur dioxide removal	46	127	--	--	--	--
Fill	26	35	W	W	34	51
Other uses[1]	1,496	3,339	1,877	4,867	1,245	3,599
Total[2]	57,074	135,964	62,453	160,352	63,551	188,130

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes stone used for lime manufacture, mine dusting, unspecified uses, and uses indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 9.—Illinois: Crushed limestone sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Adams	862	7,054	955	8,209	1,003	9,202
Calhoun	W	W	W	W	21	45
Carroll	178	410	329	759	434	1,064
Christian	W	1,290	W	1,500	425	1,379
Clark	529	1,840	W	W	W	W
Clay	W	W	W	W	180	757
Clinton	W	W	W	W	113	245
Coles	W	1,698	438	1,911	W	W
Cook	15,731	32,619	15,684	32,525	W	W
Douglas	505	1,592	W	W	W	W
Du Page	W	W	W	W	450	1,457
Effingham	1	3				
Fayette	W	W	W	663	W	751
Ford	(1)	1				
Fulton	1	2				
Greene	W	W	314	893	W	W
Hancock	297	761	352	958	357	1,003
Hardin	2,151	4,247	2,767	5,591	2,948	6,636
Henderson	371	1,043	398	1,170	365	1,205
Henry	W	W	W	W	397	1,449
Iroquois	W	W	W	W		
Jackson	212	W	W	W	W	W
Jersey	W	132	104	302	105	333
Jo Daviess	262	345	266	400	466	848
Johnson	W	W	W	W	1,430	2,990
Kane	1,043	2,521	1,397	3,592	1,411	3,956
Lake	157	392	203	508	15	32
La Salle	2,132	4,206	2,285	5,642	2,272	6,388
Lawrence			49	98		
Lee	1,337	2,535	1,475	3,057	1,409	3,208
Livingston	2,823	8,017	2,078	6,727	1,740	6,964
Logan	W	W	320	1,295	W	W
Macon	1	2			(1)	(1)
Madison	1,067	3,072	1,231	3,603	1,206	3,854
Marion	W	W	W	W		
Menard	W	W	843	2,191	W	W
Mercer	9	26			150	236
Montgomery	1,625	4,302	1,779	5,017	1,801	5,444
Ogle	886	1,963	878	2,307	702	1,879
Peoria	260	717	284	809	199	700
Perry	60	102				
Pike	358	853	778	2,385	640	2,079
Rock Island	W	W	1,394	4,710	1,390	4,977
St. Clair	2,034	4,513	2,713	6,943	2,739	7,089
Shelby	W	W	W	W	53	164
Stephenson	257	518	447	1,088	376	928
Union	W	W	W	W	1,759	4,687
Warren	741	1,683	899	2,476	1,001	3,122
Washington	W	W	W	W	149	W
Will	5,328	10,868	5,288	12,141	6,480	17,768
Williamson	55	151			10	27
Winnebago	877	1,687	870	1,499	932	1,812
Undistributed[2]	14,924	34,769	15,644	39,380	28,433	83,450
Total[3]	57,074	135,964	62,453	160,352	63,551	188,130

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Less than 1/2 unit.

[2] Includes Boone, Brown, De Kalb, Kankakee, Kendall, McDonough, Monroe, Pulaski, Randolph, Schuyler, Scott, Vermilion, and Whiteside Counties, stone that cannot be assigned to specific counties, and data indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Sulfur.— Illinois ranked 6th in the Nation in recovery of elemental sulfur in 1978 and 1979. Six companies in seven counties recovered sulfur as a byproduct of oil refinery operations.

Vermiculite.—W. R. Grace & Co., Cook County; Mica Pellets, Inc., De Kalb County; and International Vermiculite Co., Macoupin County, produced exfoliated vermiculite. Raw material was imported from out of State, and the product was used in block and loosefill insulation, concrete aggregate, and for horticultural purposes.

METALS

Iron Oxide Pigments.—Illinois led the United States in production of finished iron oxide pigments in 1978 and 1979, contributing about 26% of the national total. The Prince Manufacturing Co., Inc., George B. Smith Chemical Works, Inc., Pfizer, Inc., and Solomon Grinding Service reported production of finished natural and synthetic iron oxide pigments.

Iron and Steel.—Illinois ranked fifth in

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output among the 14 States that produced pig iron in 1978 and 1979. Blast furnaces were operated by Interlake, Inc., Wisconsin Steel Div. of Environdyne Corp., Republic Steel Corp., and U.S. Steel Corp. in South Chicago; and by Granite City Steel Div. of National Steel Corp. in Granite City.

The Illinois steel industry continued to upgrade its plants and facilities. National Steel began a $60 million improvement program featuring improved producing equipment and greater use of steel scrap at its Granite City Steel Div. Republic Steel broke ground for a new 60-oven coke battery in Chicago, with completion scheduled for 1981. Wisconsin Steel received a $90 million private loan guaranteed by the U.S. Department of Commerce to modernize its South Chicago plant.

Lead, Silver, and Zinc.—Minor amounts of lead, silver, and zinc were recovered as coproducts at fluorspar operations in Hardin County.

Other Metals.—Smelter production of cadmium continued in St. Clair County in 1978 and 1979. Alcan Aluminum Corp. planned to increase the capacity of its aluminum smelter in Will County from 12,000 short tons per year to 24,000 short tons per year, and also planned to construct a powder plant, which was scheduled for completion in 1980.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

[2] Physical scientist, Bureau of Mines, Pittsburgh, Pa.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives, tripoli:			
Illinois Minerals Co	2035 Washington Ave. Cairo, IL 62914	Underground mine.	Alexander.
Tammsco, Inc	Box J Tamms, IL 62988	do	Do.
Barite:			
Allied Chemical Corp	Box 531 Cave In Rock, IL 62919	Plant	Hardin.
Cement:			
Illinois Cement Co., subsidiary of Centex Corp.	Box 442 La Salle, IL 61301	do	La Salle.
Marquette Co	Portland Ave. Oglesby, IL 61348	do	Do.
Medusa Corp	East River Rd. Dixon, IL 61021	do	Lee.
Missouri Portland Cement Co	Box 147 Joppa, IL 62953	do	Massac.
Clay and shale:			
American Brick Co	6558 West Fullerton Ave. Chicago, IL 60635	Pit and plant	Cook.
Lowe's Inc	Box 68 Olmstead, IL 62970	do	Pulaski.
Richards Brick Co	234 Springer Ave. Edwardsville, IL 62025	do	Bond.
Streator Brick Systems, Inc	West 9th St. Streator, IL 61364	Pits and plants	La Salle and Livingston.
Valley View Dirt & Gravel Co	R.F.D. 1 Cornell, IL 61319	Pit and plant	Livingston.
Fluorspar:			
Allied Chemical Corp	Cave In Rock, IL 62919	Underground mines, and mill.	Hardin.
Hastie Mining Co	do	Open pit	Do.
Ozark-Mahoning Co	Box 57 Rosiclare, IL 62982	Underground mines, mill, plant.	Do.
Gypsum:			
National Gypsum Co	515 Sea Horse Dr. Box 139 Waukegan, IL 60085	Mill	Lake.
Iron and steel:			
Granite City Steel Div. of National Steel Corp.	20th and State Sts. Granite City, IL 62040	Iron and steel furnaces.	Madison.
Interlake, Inc	13500 South Perry Ave. Riverdale, IL 60627	Iron furnaces	Cook.
Republic Steel Corp	Suite 550, Commerce Plaza Oak Brook, IL 60521	Iron and steel furnaces.	Do.
United States Steel Corp	3426 East 89th St. Chicago, IL 60617	do	Do.
Wisconsin Steel Div. of Envirodyne Corp.	2800 West 106th St. Chicago, IL 60617	do	Do.
Iron oxide pigments, finished:			
Pfizer, Inc	2001 Lynch Ave. East St. Louis, IL 62201	Plant	St. Clair.
The Prince Manufacturing Co., Inc	700 Lehigh St. Bowmanstown, PA 18030	do	Adams.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Lead, silver, zinc:			
Allied Chemical Corp	Cave In Rock, IL 62919	Underground mines and mill.	Hardin.
Ozark-Mahoning Co	Box 57 Rosiclare, IL 62982	do	Do.
Lime:			
Marblehead Lime Co	300 West Washington St. Chicago, IL 60606	Kilns	Cook.
Vulcan Materials Co	500 Plainfield Rd. Box 6 Countryside, IL 60525	do	Do.
Peat:			
Anderson Peat Co. of Illinois	R.R. 3 Morrison, IL 61270	Bog and processing plant.	Whiteside.
Markman Peat Co	Route 3 Morrison, IL 61270	do	Do.
Perlite, expanded:			
Johns-Manville Perlite Corp	Route 6, Box 864 Joliet, IL 60434	Plant	Will.
Silbrico Corp	6300 South River Rd. Hodgkins, IL 60525	do	Cook.
Sand and gravel:			
Elmhurst-Chicago Stone Co	400 West 1st St. Box 57 Elmhurst, IL 60126	Pits and plants	Du Page, Kane, Will.
General Dynamics Corp	300 West Washington St. Chicago, IL 60606	do	Cook, Du Page, Grundy, Kane, McHenry, Will.
McHenry Sand & Gravel Co., Inc	1819 Dot, Box 511 McHenry, IL 60050	do	McHenry.
Martin Marietta	Box 789 Cedar Rapids, IA 52406	do	Ogle, Peoria, Tazewell, Winnebago.
Meyer Aggregate	Box 56, Route 2 Algonquin, IL 60102	do	Kane and McHenry.
Road Materials Corp	Route 68 East Dundee, IL 60118	do	Do.
Vulcan Materials Co	500 Plainfield Rd. Box 6 Countryside, IL 60525	do	Cook and McHenry.
Stone:			
Anna Quarries, Inc	Box 180 Anna, IL 62906	Quarry and plant	Union.
Columbia Quarry Co	Box 128 Columbia, IL 62236	Quarries and plants.	Monroe and Pulaski.
General Dynamics Corp	300 West Washington St. Chicago, IL 60606	Underground mine, quarries, plants.	Cook, Vermilion, Will.
Medusa Aggregates Co	Route 6, Box 111-A Lehigh Rd. Kankakee, IL 60901	Quarries and plants.	Clark, Henderson, Kankakee, Livingston.
Missouri Portland Cement Co	Cave In Rock, IL 62919	Quarry and plant	Hardin.
Moline Consumers Co	313 16th St. Moline, IL 61255	Quarries and plants.	Rock Island.
Pontiac Stone Co	Five Vermillion Plaza Box 412 Pontiac, IL 61764	do	Livingston.
Southern Illinois Stone Co	Box 38 Buncombe, IL 62912	Quarry and plant	Johnson.
Vulcan Materials Co	500 Plainfield Rd. Box 6 Countryside, IL 60525	Quarries and plants.	Cook and Will.
Sulfur, recovered:			
Marathon Oil Co	Robinson, IL 62454	Plant	Crawford.
Mobil Oil Corp	Box 874 Joliet, IL 60434	do	Will.
Union Oil Co. of California	1650 East Golf Rd. Schaumburg, IL 60196	do	Cook.
Vermiculite, exfoliated:			
W. R. Grace & Co	6051 West 65th St. Bedford Park, IL 60638	do	Do.
International Vermiculite Co	1st and Mound Sts. Girard, IL 62640	do	Macoupin.
Mica Pellets, Inc	1120 Oak St. De Kalb, IL 60115	do	De Kalb.

The Mineral Industry of Indiana

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey, Indiana Department of Natural Resources, for collecting information on all nonfuel minerals.

By James J. Hill[1] and L. J. Prosser, Jr.[2]

The value of Indiana's nonfuel mineral production was $291 million in 1978 and $326 million in 1979. Although value surpassed the $300 million mark for the first time in 1979, output declined in all commodities except abrasives, peat, and stone. The following, in decreasing order of value, continued as the State's leading commodities: Portland cement, crushed stone, and sand and gravel. Clays, gypsum, masonry cement, dimension stone, and lime were also produced. Imported materials processed in the State included fluorspar and perlite.

Table 1.—Nonfuel mineral production in Indiana[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement, portland ____ thousand short tons__	W	W	W	W	2,389	$95,549
Clays ____do____	1,268	$2,237	1,277	$2,495	1,185	2,341
Peat ____do____	51	759	57	789	76	1,242
Sand and gravel ____do____	26,248	50,069	27,600	54,380	[2]27,050	[2]55,842
Stone:						
Crushed ____do____	26,740	61,392	33,394	80,523	34,134	92,533
Dimension ____do____	244	11,804	234	12,972	340	19,543
Combined value of abrasives (natural), cement (masonry), gypsum, lime, sand and gravel (industrial, 1979), and values indicated by symbol W ____	XX	120,445	XX	139,830	XX	59,036
Total ____	XX	246,726	XX	290,989	XX	326,086

W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes industrial sand and gravel; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Indiana, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Adams	W	W	Stone, sand and gravel.
Allen	W	W	Stone, sand and gravel, peat.
Bartholomew	W	W	Stone, sand and gravel.
Blackford	W	W	Stone.
Boone	W	W	Sand and gravel.
Carroll	W	W	Stone, sand and gravel.
Cass	W	W	Cement, stone, sand and gravel, clays.
Clark	W	W	Do.
Clay	$512	$495	Clays.
Clinton	350	--	
Crawford	6,403	8,872	Stone.
Daviess	263	263	Sand and gravel.
Dearborn	W	W	Do.
Decatur	W	W	Stone.
De Kalb	1,142	835	Sand and gravel.
Delaware	W	W	Stone, sand and gravel.
Dubois	W	W	Clays.
Elkhart	1,352	746	Sand and gravel, stone.
Fayette	W	W	Sand and gravel.
Floyd	W	W	Do.
Fountain	W	W	Sand and gravel, clays.
Franklin	W	W	Sand and gravel, stone.
Fulton	W	261	Sand and gravel.
Gibson	263	263	Do.
Grant	W	W	Stone, sand and gravel.
Greene	W	W	Sand and gravel.
Hamilton	W	W	Sand and gravel, stone, peat.
Hancock	W	W	Sand and gravel, peat.
Harrison	W	W	Sand and gravel, stone.
Henry	876	1,110	Sand and gravel.
Howard	W	W	Sand and gravel, stone.
Huntington	W	W	Stone, sand and gravel, clays.
Jackson	W	W	Sand and gravel, clays.
Jasper	W	W	Sand and gravel, stone, peat.
Jay	W	W	Stone, sand and gravel.
Jennings	W	W	Stone.
Johnson	368	233	Sand and gravel.
Knox	W	1,195	Do.
Kosciusko	1,197	1,334	Do.
Lagrange	W	411	Do.
Lake	W	W	Lime, cement, clays.
La Porte	W	W	Sand and gravel, peat.
Lawrence	W	W	Cement, stone, clays.
Madison	W	W	Stone, sand and gravel, peat.
Marion	W	W	Sand and gravel, stone.
Marshall	W	W	Sand and gravel, peat, stone.
Martin	W	W	Gypsum.
Miami	W	W	Stone, sand and gravel.
Monroe	W	W	Stone.
Montgomery	W	W	Sand and gravel, clays.
Morgan	W	W	Sand and gravel, clays, stone.
Newton	W	W	Stone.
Noble	476	529	Sand and gravel, stone.
Ohio	W	W	Sand and gravel.
Orange	W	W	Stone, abrasives.
Owen	W	W	Stone, sand and gravel.
Parke	W	651	Sand and gravel.
Perry	W	W	Stone.
Pike	11	--	
Porter	W	W	Sand and gravel, clays.
Posey	W	W	Sand and gravel.
Pulaski	766	W	Stone.
Putnam	24,992	W	Cement, stone, clays, sand and gravel.
Randolph	W	W	Stone, sand and gravel.
Ripley	W	W	Stone.
Rush	W	W	Stone, sand and gravel.
St. Joseph	1,908	2,254	Sand and gravel, stone.
Scott	W	W	Stone.
Shelby	W	2,573	Stone, sand and gravel.
Stark	8	--	
Steuben	607	2,271	Sand and gravel, stone.
Sullivan	207	W	Do.
Switzerland	2,690	W	Do.
Tippecanoe	2,223	2,378	Sand and gravel.
Tipton	W	W	Do.
Union	9	--	
Vanderburgh	W	W	Sand and gravel.
Vermillion	W	W	Sand and gravel, clays.
Vigo	W	W	Sand and gravel, stone.
Wabash	W	W	Stone, sand and gravel.
Warren	1,322	1,650	Sand and gravel.
Washington	W	W	Stone.
Wayne	1,633	W	Sand and gravel, stone.
Wells	W	W	Stone, peat.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Indiana, by county[1] —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
White	$819	W	Stone.
Whitley	W	W	Sand and gravel.
Undistributed[2]	196,325	$262,658	
Total[3]	246,726	290,989	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] The following counties are not listed because no nonfuel mineral production was reported: Benton, Brown, Hendricks, Jefferson, Spencer, and Warrick.

[2] Includes values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Indiana business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	2,466.0	2,577.0	2,610.0	+1.3
Unemployment	do	141.0	146.0	167.0	+14.4
Employment (nonagricultural):					
Mining [1]	do	8.3	9.0	10.7	+18.9
Manufacturing	do	713.2	791.5	740.9	-.1
Contract construction	do	91.9	100.6	108.9	+8.3
Transportation and public utilities	do	105.6	109.0	111.4	+2.2
Wholesale and retail trade	do	459.3	482.3	499.9	+3.6
Finance, insurance, real estate	do	94.0	97.5	101.2	+3.8
Services	do	299.8	316.7	332.7	+5.1
Government	do	342.0	349.1	353.9	+1.4
Total nonagricultural employment[1]	do	2,114.0	[2]2,205.5	[2]2,259.7	+2.5
Personal income:					
Total	millions	$37,012	$41,398	$46,903	+13.3
Per capita		$6,918	$7,703	$8,686	+12.8
Construction activity:					
Number of private and public residential units authorized		38,178	[3]35,051	29,721	-15.2
Value of nonresidential construction	millions	$425.8	$565.8	$620.1	+9.6
Value of State road contract awards	do	$137.0	$150.0	$173.0	+15.3
Shipments of portland and masonry cement to and within the State	thousand short tons	1,806	1,926	1,827	-5.1
Nonfuel mineral production value:					
Total crude mineral value	millions	$246.7	$291.0	$326.1	+12.1
Value per capita, resident population		$46	$54	$60	+11.1
Value per square mile		$6,799	$8,018	$8,985	+12.1

[p] Preliminary.

[1] Includes bituminous coal and oil and gas extraction.

[2] Data do not add to total shown because of independent rounding.

[3] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Trends and Developments.—Indiana's manufacturing industry is heavily dependent upon minerals and the State's excellent transport system. The Great Lakes and St. Lawrence Seaway on the north and the Ohio River on the south are used by lake freighters, ships, and barges to move large quantities of minerals and manufactured goods in and out of the State.

In 1978, for the first time, the Port of Indiana, east of Gary, handled more than 1 million short tons of cargo; this included several mineral commodities. In 1979, tonnage increased by 10%. In addition, millions of tons of taconite pellets, limestone, and coke were shipped into the private

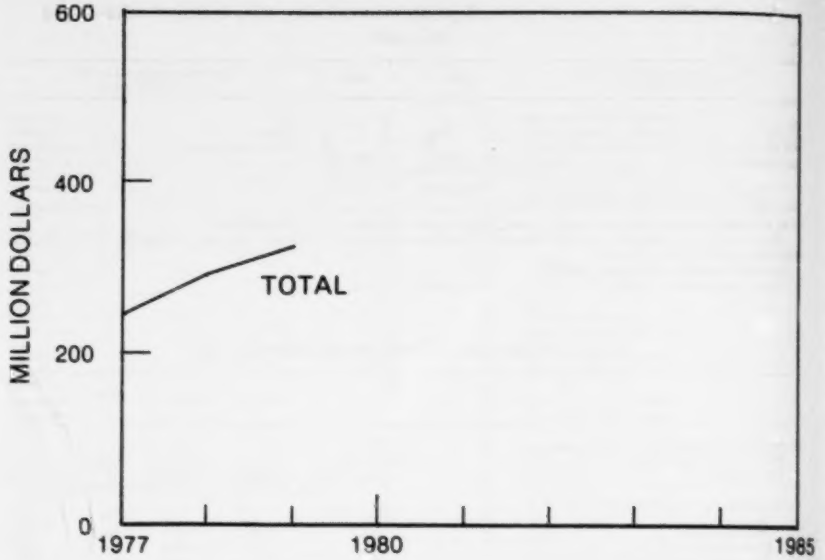

Figure 1.—Total value of nonfuel mineral production in Indiana.

berths of steel companies that abut the port on both the east and west.

Mount Vernon's new Ohio River port, the Southwind Maritime Center, was dedicated in 1979 and has provided a financial boost to southern Indiana's economy. Another Ohio River port, the Clark Maritime Center, was scheduled for construction near Jeffersonville. A permit to start work was issued by the U.S. Army Corps of Engineers in 1979.

Along with an extensive transportation network, Indiana's tax structure provides a favorable climate for economic growth. The State excludes business inventories from the personal property tax, and does not have a sales tax on industrial machinery.

According to the Indiana Department of Commerce, the State gained about 1,500 companies during 1974-78, which resulted in a total investment of $6.2 billion and the creation of about 47,000 jobs. Foreign investors also contributed significantly to Indiana's economy in both dollars and jobs. There were 47 firms with at least 10% foreign ownership in mid-1976. By June 1977, there were 54 such firms, employing 12,500 people. During 1978, nearly 21,000 people were employed by foreign-owned companies, with a combined annual payroll totaling nearly $300 million.

Legislation and Government Programs.—During 1978-79, the Indiana Legislature enacted several laws that relate to the mineral industry; two of these laws are listed below:

Public Law 13 required the purchase of domestic steel for all public works projects in Indiana, except when the domestic steel price exceeds the foreign price by 15%, or when there is an insufficient quantity of domestic steel to meet the requirements of a public works contract.

Public Law 159 empowered the Department of Natural Resources to enforce provisions of the Federal Surface Mining Control and Reclamation Act of 1977 and established performance standards.

Other State legislation established and revised air pollution control standards and monitoring procedures, amended standards concerning occupational exposure to lead and inorganic arsenic, and provided for the certification of geologists.

The State had difficulty in establishing a Mining and Mineral Resources and Research Institute under the provisions of Title III of Public Law 95-87, the Federal Surface Mining Control and Reclamation Act of 1977. Senate Concurrent Resolution 27 approved Indiana State University at Evansville, whereas the Governor had previously designated Indiana University at Bloomington to receive the Federal funds. Because the two branches of State government disagreed, Federal law required that a decision be made by a nine-member Federal Advisory Committee on Mining Research appointed by the Secretary of the Interior. On December 19, 1979, Purdue University at West Lafayette was designated.

In 1978-79, the Geological Survey, Indiana Department of Natural Resources, Bloomington, continued geological research and completed several long-term projects to digitize data. The projects included a system to plot base maps of selected geographic units by computer.

A revised Indianapolis1° x 2° Regional Geologic Map was published, along with maps showing bedrock and unconsolidated deposits. Other publications discussed stratigraphy, environmental geology, mineral economics, and peat and crushed stone resources. Two mineral producer directories were also published.

In 1979, Indiana's Coastal Zone Management Program was in its third year of development. At yearend, proposed legislation was being developed by the State Planning Service Agency for submittal to the State legislature, for review in early 1980. If adopted, the program would regulate access, economic development, natural hazard areas, fish and wildlife habitat, energy facility siting, and dredge disposal areas along Indiana's 45-mile Lake Michigan shoreline. Several steel mill facilities and the Port of Indiana are located in the coastal area. In conjunction with the program, studies were conducted that identified and documented wetlands, natural areas, and manmade land areas along the coast.

The Indiana Energy Search Center opened in 1979 to provide information on ways to cut energy costs and consumption to mining and other industries. The facility is linked to a worldwide network of computer bases to aid in the transfer of information. It is funded by a Federal grant and operated by the Indiana Department of Commerce.

In 1977, the Forest Service of the U.S. Department of Agriculture initiated its Roadless Area Review and Evaluation (RARE II) program. The program identified roadless and undeveloped land areas in the National Forest System suitable for wilderness use. In 1979, three areas in the Hoosier National Forest were evaluated; two areas (9,909 acres) were nominated for wilderness status, and one area (7,000 acres) was found unsuitable for wilderness use. Congressional action on the areas selected for wilderness is expected in the near future.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives.—Natural abrasives were produced by Hindostan Whetstone Co. from a sandstone quarry near Orleans, Orange County. The firm, one of the oldest manufacturing establishments in Indiana, shaped the stone into cuticle removers and sharpening stones.

Manufacturing abrasives of steel and aluminum were produced by Wheelabrator-Frye, Inc., at Mishawaka, in St. Joseph County, for use by the steel industry.

Cement.—In 1979, Indiana was one of 11 States with cement shipments (portland) of over 2 million short tons, ranking ninth nationally. Four companies produced cement at five plants in Cass, Clark, Lake, Lawrence, and Putnam Counties during 1978-79. Two plants, using the dry grinding process, produced portland cement, two plants with wet grinding facilities produced portland and masonry cement, and one plant using the wet grinding process produced portland, masonry, and calcium aluminate cement.

Approximately 90% of the cement produced was Type I (general construction use) and Type II (moderately low heat and moderate degree of resistance to sulfate attack). Much of the remainder was Type III (high early strength).

Production decreased slightly in 1978, mainly because of a fuel shortage effected by a coal strike, a strike by cement employees, and environmental regulations. The drop in production and increased demand by the construction industry led to a cement shortage in the latter part of 1978 and early 1979. Some plants shipped on an allocation basis to supply regular customers.

In 1978, Universal Atlas Cement, a division of United States Steel Corp., Buffington, was ordered by the Environmental Protection Agency to reduce particulate emissions from two kilns. The plant curtailed production while pollution abatement equipment was installed. By January 1979, particulate emissions were within mandated limits, allowing full operation to resume. At yearend, however, United States Steel announced that the Buffington cement plant was one of a number of operations around the country scheduled for permanent closing.

Clays.—In 1979, clay and shale were mined by 17 companies at 20 pits. Approximately 50% of the production was from Clay and Morgan Counties, in the west-central part of the State. Clay and shale were used in the manufacture of construction materials, such as lightweight aggregate, brick, cement, and tile. A decrease in construction activity in 1979 resulted in a decline in clay and shale production, compared with that of the previous year.

In 1978, General Shale Products Corp. initiated a new coal-firing system for its brick tunnel kiln at the Mooresville plant in Morgan County. The firm has a patent on the system, which uses low-ash and low-sulfur coal imported from Tennessee. The coal is crushed, screened, and dried at the plant and then blown into the kiln. The coal system uses 30% less energy than oil or natural gas to produce brick; however, oil or natural gas is needed to start the kiln and bring it up to operating temperatures.

Bloomington Crushed Stone Co., Inc., a leading producer of common clay in 1977-78, reported no production for 1979 from its Lawrence County operation.

Table 4.—Indiana: Clays sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Year	Fire clay		Common clay		Total[1]	
	Quantity	Value	Quantity	Value	Quantity	Value
1975	2	16	1,092	1,945	1,094	1,961
1976	2	21	1,263	2,288	1,265	2,309
1977	1	20	1,266	2,216	1,268	2,237
1978	1	15	1,276	2,480	1,277	2,496
1979	1	15	1,184	2,325	1,185	2,341

[1] Data may not add to totals shown because of independent rounding.

Fluorspar.—Briquets were fabricated from fluorspar obtained from England, Mexico, South Africa, and domestic producers by National Briquet Corp. at its Lake County facility in East Chicago. The briquets were sold to the steel industry for use as a flux.

Gypsum.—Indiana ranked sixth among the 22 producing States in 1979. Crude gypsum was mined by United States Gypsum Co. and National Gypsum Co. from underground sites in Martin County, in southwestern Indiana. United States Gypsum operated a calcining plant in Lake County in the northwestern part of the State, and additional gypsum was imported from Michigan by lake carrier. Miles Laboratories, Inc., calcined byproduct gypsum in Elkhart County, in northern Indiana. Most of the gypsum was calcined for use in wallboard and sheathing. A lesser quantity was sold for use in the manufacture of cement. United States Gypsum completed expansion of its wallboard plant, which increased capacity by 25%.

In 1979, the United States Gypsum's underground mine at Shoals was named the safest nonmetal mine in the Nation by the American Mining Congress and the U.S. Department of Labor and received the Sentinels of Safety Award. Mine personnel established a record of over 1.9 million employee hours without a disabling injury.

Lime.—During 1978-79, Indiana ranked sixth in the Nation in lime production. Two firms, Marblehead Lime Co., Buffington, and Inland Steel Co., Indiana Harbor, produced quicklime in Lake County. Most of the lime was used by the steel industry to increase the fluidity of slag.

Peat.—Nationally, Indiana continued to rank fourth in the production of peat, accounting for about 9% of the output in 1978-79. Reed sedge and humus were produced in nine counties and processed for soil conditioning and horticultural purposes. Peat was harvested using vacuum equipment and standard earth-moving machinery.

Perlite.—Imported perlite mined in New Mexico was expanded by five companies operating six plants. United States Gypsum Co. operated plants in Lake and Martin Counties; National Gypsum Co., in Martin County; Grefco, Inc., in Montgomery County; Chemrock Corp., in Tippecanoe County; and Johns-Manville Corp., in Madison County. Production during 1978-79 totaled almost 50,000 short tons valued at $5.9 million. Principal uses were for filter aids, fillers, plaster aggregates, cavity fill, and roof insulation board.

Sand and Gravel.—Indiana's sand and gravel industry remained stable in 1978-79. During the biennium, little change occurred in tonnage or in the number of mining operations, processing plants, and companies. Construction sand and gravel accounted for most of the production; it was used mainly for concrete aggregate, roadbase, fill, and asphaltic concrete.

Indiana produced a small quantity of industrial sand in La Porte, Warren, and Porter Counties. Major uses were for refractories, silicon carbide manufacture, and foundry molding and core. Most of Indiana's glassmaking companies imported sand from out of State. Rail deliveries averaged about 3,000 short tons per day to eight glass manufacturers in the west-central part of the State.

Slag.—Indiana ranked third nationally in the production of blast furnace slag during 1978-79. Once a major waste problem for the iron and steel industry, slag currently has a myriad of applications in many phases of construction. Slag was used as all-purpose construction aggregate, road base material, bituminous aggregate, railroad ballast, filter media, and for septic tank absorption beds.

Stone.—During both 1978 and 1979, Indiana ranked 15th nationally in total stone production, and first in dimension stone output. Of all stone mined in 1979, lime-

Table 5.—Indiana: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	10,595	$22,675	$2.14	10,553	$22,583	$2.14	10,832	$25,126	$2.32
Plaster and gunite sands	NA	NA	NA	84	136	1.62	W	W	W
Concrete products	1,504	3,145	2.09	1,246	2,352	1.89	747	1,574	2.11
Asphaltic concrete	5,883	11,641	1.98	6,222	12,735	2.05	5,576	11,654	2.09
Roadbase and coverings	3,786	6,391	1.69	4,322	8,107	1.88	4,530	8,694	1.92
Fill	3,642	4,171	1.15	4,064	5,686	1.40	4,463	7,094	1.59
Snow and ice control	NA	NA	NA	392	692	1.76	459	861	1.88
Railroad ballast	--	--	--	7	10	1.32	(1)	1	2.80
Other uses	496	857	1.73	388	728	1.87	443	838	1.89
Total[2] or average	25,907	48,881	1.89	27,280	53,030	1.94	27,050	55,842	2.06

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Less than 1/2 unit.

[2] Data may not add to totals shown because of independent rounding.

Table 6.—Indiana: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	12,750	$22,060	$1.73	13,703	$24,431	$1.78	13,367	$25,579	$1.91
Gravel	13,157	26,821	2.04	13,577	28,598	2.11	13,683	30,263	2.21
Total[1] or average	25,907	48,881	1.89	27,280	53,030	1.94	27,050	55,842	2.06
Industrial sand	341	1,208	3.54	322	1,345	4.18	W	W	W
Grand total[1] or average	26,248	50,089	1.91	27,600	54,380	1.97	W	W	W

W Withheld to avoid disclosing company proprietary data.

[1] Data may not add to totals shown because of independent rounding.

Table 7.—Indiana: Construction sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Adams	244	437	262	478	232	457
Allen	974	1,617	609	957	512	795
Bartholomew	W	529	W	647	W	636
Carroll	W	W	W	W	37	81
Cass	279	555	246	513	328	624
Clark	150	263	150	263	150	263
Clinton	200	350	--	--	W	W
Daviess	150	263	150	263	150	263
De Kalb	663	1,142	470	835	534	942
Delaware	383	578	387	541	396	678
Elkhart	798	1,342	414	737	380	785
Fountain	604	1,201	575	1,331	564	1,476
Fulton	W	W	W	261	W	255
Gibson	150	263	150	263	W	W
Grant	489	1,014	W	W	W	W
Hamilton	1,490	3,591	1,819	4,093	1,942	4,602
Hancock	182	335	174	327	W	W
Henry	448	876	W	W	W	W
Huntington	W	W	235	W	259	W
Jackson	W	W	411	649	W	648
Johnson	200	368	112	233	78	183
Knox	W	W	615	1,195	639	1,240
Kosciusko	741	1,197	793	1,334	899	1,459
Lagrange	324	542	250	411	224	384
Lake	--	--	--	--	W	W
Madison	441	795	690	1,489	691	1,491
Marion	2,474	5,038	2,800	5,946	2,377	5,613
Marshall	W	W	W	W	313	523
Miami	240	506	27	40	121	269
Morgan	702	1,341	1,084	2,002	1,014	2,227
Noble	296	471	370	525	W	W
Parke	292	548	288	651	343	735
Pike	5	11	--	--	--	--
Posey	W	W	10	15	10	15
Randolph	153	255	153	255	W	W
Rush	27	37	32	45	23	33
St. Joseph	1,145	1,907	1,304	2,252	1,564	2,776
Shelby	413	749	386	767	468	1,017
Starke	7	8	--	--	--	--
Steuben	361	603	1,209	2,268	523	774
Sullivan	92	151	W	W	W	W
Switzerland	1,425	2,550	1,480	W	1,520	W
Tippecanoe	1,099	2,223	1,152	2,378	W	W
Union	5	9	--	--	--	--
Vanderburgh	W	W	W	W	191	191
Vermillion	477	900	757	1,431	499	1,176
Vigo	287	599	478	1,000	377	878
Wabash	55	74	36	63	W	W
Wayne	499	1,067	478	1,013	521	1,113
Undistributed[1]	6,943	12,584	6,723	15,562	9,171	21,243
Total[2]	25,907	48,881	27,280	53,030	27,050	55,842

W Withheld to avoid disclosing company proprietary data; included in "Undistributed."

[1] Includes Boone, Dearborn, Fayette, Floyd, Franklin, Greene, Harrison, Howard, Jasper, Jay, La Porte, Montgomery, Ohio, Owen, Putnam, Tipton, Warren, and Whitley Counties and some sand and gravel figures that cannot be assigned to specific counties.

[2] Data may not add to totals shown because of independent rounding.

stone was extracted at 107 sites, marl at four, and sandstone at one. Crushed limestone was used mainly for road base, aggregate, and in cement manufacture. Dimension limestone was mined at 20 locations, and dimension sandstone at one. Uses were for rough blocks, sawed stone, and cut stone.

Developments in Indiana's stone industry included a plan by Martin Marietta Aggregates to open an underground limestone mine in Marion County in 1981. Construction began in 1979, and the operation was expected to produce 1.5 million short tons of crushed stone annually. Marblehead Lime Co., a subsidiary of General Dynamics Corp., planned to develop a crushed stone operation in Carroll County. Cost was estimated at $20 million and plant production capacity at 1,000 short tons per day. Medusa

Table 8.—Indiana: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	2,090	4,908	2,405	6,052	2,198	6,727
Agricultural marl	18	33	16	22	13	19
Concrete aggregate	[r]3,767	[r]9,225	4,089	10,267	5,773	15,483
Bituminous aggregate	2,592	6,066	3,723	9,219	3,433	9,760
Macadam aggregate	1,513	3,645	1,872	4,825	1,656	4,777
Dense-graded roadbase stone	4,779	10,907	7,027	16,321	7,859	21,986
Surface treatment aggregate	961	2,447	1,235	3,341	1,272	3,729
Other construction aggregate and roadstone	6,662	15,506	8,697	21,083	6,867	17,917
Riprap and jetty stone	301	903	304	851	314	1,019
Railroad ballast	248	485	314	782	648	1,755
Manufactured fine aggregate (stone sand)	65	106	35	94	109	301
Terrazzo and exposed aggregate	--	--	--	--	1	2
Cement manufacture	3,159	5,019	3,115	5,319	3,388	6,206
Fill	--	--	39	75	W	W
Sulfur dioxide removal	68	187	W	W	W	W
Other uses[2]	517	1,955	523	2,322	605	2,851
Total[3]	26,740	61,392	33,394	80,523	34,134	92,533

[r]Revised. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Includes limestone and marl.

[2] Includes stone used for poultry grit and mineral food, filter stone, flux stone, mine dusting, asphalt filler, glass manufacture, roofing granules (1979), unspecified uses, and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 9.—Indiana: Dimension stone[1] sold or used by producers, by use

Use	1977			1978			1979		
	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)
Rough blocks	[r]133,091	1,783	$3,796	121,560	1,632	$3,749	195,245	2,509	$5,960
Irregular-shaped stone	7,104	99	165	2,540	36	79	1,800	24	68
Rough flagging	6,939	96	107	7,592	105	116	W	W	W
Other rough stone	421	6	2	--	--	--	--	--	--
Cut stone	[r]24,672	338	4,801	30,798	421	5,593	35,349	486	8,270
Sawed stone	[r]34,572	476	2,402	34,018	463	2,236	53,400	734	3,676
House stone veneer	[r]24,432	340	921	25,874	359	1,056	34,214	471	1,345
Dressed flagging	W	W	W	1,042	14	28	W	W	W
Other uses[2]	13,040	179	109	10,600	146	115	20,384	281	224
Total[3]	[r]244,271	3,317	11,804	234,024	3,177	12,972	340,392	4,505	19,543

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone and sandstone.

[2] Includes stone used for rubber, rough flagging, dressed flagging, and dressed construction (1977-78), and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 10.—Indiana: Crushed stone sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Allen	2,182	5,135	2,312	5,381	1,547	4,110
Cass	1,082	1,913	1,243	2,219	1,180	2,326

See footnotes at end of table.

Table 10.—Indiana: Crushed stone sold or used by producers, by county —Continued

(Thousand short tons and thousand dollars)

County	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Clark	2,712	5,254	2,845	6,357	3,114	7,289
Crawford	2,890	6,403	4,010	8,872	3,517	8,148
Elkhart	7	10	6	9	6	10
Franklin	--	--	W	W	W	W
Hamilton	1,316	3,325	1,418	3,693	2,454	6,129
Harrison	422	859	W	W	453	1,179
Lagrange	W	W	--	--	--	--
Lake	25	114	--	--	--	--
Lawrence	1,619	3,474	2,524	5,089	2,491	6,843
Marshall	W	W	W	W	--	--
Noble	6	5	W	4	W	W
Orange	542	1,283	646	1,605	670	1,898
Pulaski	320	760	W	W	W	W
Putnam	2,638	6,184	3,037	7,509	3,024	8,309
St. Joseph	W	1	W	W	W	W
Shelby	W	W	788	1,806	515	1,668
Steuben	1	4	2	3	1	1
Sullivan	12	56	15	70	16	96
Switzerland	W	140	W	147	W	W
Vigo	W	W	W	W	--	--
Wabash	W	W	W	W	--	--
Wayne	208	576	398	W	270	W
White	327	819	W	W	W	W
Undistributed[1]	10,450	25,075	14,170	37,757	14,878	44,620
Total[2]	26,740	61,392	33,394	80,523	34,184	92,533

W Withheld to avoid disclosing company proprietary data; included in "Undistributed."

[1] Includes Adams, Bartholomew, Blackford, Carroll, Decatur, Delaware, Grant, Howard, Huntington, Jasper, Jay, Jennings, Madison, Marion, Miami, Monroe, Morgan, Newton, Owen, Perry, Randolph, Ripley, Rush, Scott, Washington, and Wells Counties and data indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Corp. was expected to invest $3.5 million in an underground mine, also in Carroll County. Both Medusa and Marblehead became interested in developing operations at the Carroll County sites after the Indiana Geological Survey defined high-calcium content deposits in 1975.

Sulfur (Recovered Elemental).—Amoco Oil Co. recovered sulfur from crude petroleum at refineries in Lake County, in northwestern Indiana. Organic sulfur compounds were converted to hydrogen sulfide by hydrogenation, and then to elemental sulfur by the Claus process.

Table 11.—Indiana: Crushed calcareous marl sold or used by producers

Year	Number of producers	Short tons	Value
1975	9	28,373	$40,845
1976	7	23,972	39,973
1977	7	16,561	25,901
1978	5	15,029	18,762
1979	4	12,728	19,424

In 1978, Rock Island Refining Corp., Marion County, constructed a sulfur reclamation plant that recovered about 7 short tons per day of sulfur as part of a $3 million improvement program.

METALS

Aluminum.—The Aluminum Co. of America (ALCOA) produced ingots and sheets at the Warrick County smelter and fabricating plant in the southwestern part of the State. Alcoa facilities in Alabama, Texas, and Jamaica supplied the raw material.

Apex International Alloys, Inc., recovered aluminum at its dross processing plant in Knox County, in southwestern Indiana.

Pig Iron and Steel.—Indiana continued to rank second after Pennsylvania in iron and steel production. The State's steel industry, centered in Lake and Porter Counties in northwestern Indiana, included Inland Steel Co., United States Steel Corp., Jones & Laughlin Steel Corp., and Bethlehem Steel Corp.

In 1978, United States Steel's Gary Works surpassed the 6-million-short-ton production mark for the first time. Improvements in steel processing and maintenance practices contributed to the new record. The essential raw materials used in making steel were provided by the company's domestic iron ore, coal, and limestone operations.

In 1978, the LTV Corp. and Lykes Corp. merged to become the Nation's third largest steelmaker in terms of production capacity. Jones & Laughlin Steel Corp., a subsidiary, restructured operations at the Indiana Harbor steel mill. The company invested $20 million to rehabilitate the plant's physical facilities. As a result, output at the 84-inch hot strip mill increased by 650 short tons to 3,500 short tons per 8-hour shift. Depending on market conditions and the availability of investment capital, a multiyear $200 million expansion and improvement program was under consideration.

Inland Steel Co. was scheduled to complete a $900 million expansion project in 1980 that was expected to increase annual capacity from 8.4 to 9.3 million short tons. As part of the program, work was completed on a 2,400-ton-per-day coke battery and a coal chemical byproducts plant. The company's fleet of vessels transported about 65% of the iron ore and limestone required for steelmaking operations.

Bethlehem Steel Corp. added a third basic oxygen steelmaking furnace and a computerized 110-inch sheared plate mill at the Burns Harbor plant. The plant's capacity was rated at 5.3 million short tons per year.

Other Metals.—Federated Metals Corp., a subsidiary of ASARCO Inc., produced plate anodes, zinc dust, brass and bronze ingot, and tin-lead alloys at its Whiting facility in Lake County. Anodes were used by the electroplating industry, zinc dust by paint and chemical manufacturers, ingot by the foundry trade, and alloys by the automobile and equipment industries.

U.S.S. Lead Refinery, Inc., a division of UV Industries, Inc., operated a secondary refinery in Lake County to recover antimonial lead and lead-alloying elements.

M.K. Metals, Inc., operated a metal pellet plant in Kosciusko County, in the northern part of the State. The company used a new mechanical process to recover recyclable steel and aluminum. The end product was a pellet suitable for remelting by smelting firms.

Consolidated Silver Recovery, Inc., recovered and refined silver at a plant north of Indianapolis in 1978 and 1979. The metal was recovered from photographic film. Hospitals were a major supplier, along with photoprocessors, microfilmers, lithographers, and firms using industrial X-rays.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasive stone:			
Hindostan Whetstone Co	Box 432 Bedford, IN 47421	Quarry and plant	Orange.
Abrasives, metallic:			
Wheelabrator-Frye, Inc	400 South Byrkit St. Mishawaka, IN 46544	Plant	St. Joseph.
Cement:			
Lehigh Portland Cement Co.[1]	718 Hamilton Mall Allentown, PA 18105	do	Lawrence.
Lone Star Industries, Inc.[1 2]	2511 East 46th St. Indianapolis, IN 46205	do	Putnam.
Louisville Cement Co.[1 2]	Box 35750 Louisville, KY 40232	Plants	Case and Clark.
Clays:			
American Brick Co	6558 West Fullerton Ave. Chicago, IL 60635	Pit and plant	Lake.
C & F Shale Co	203 South Walnut St. Brazil, IN 47834	do	Clay.
General Shale Products Corp	Box 86 Mooresville, IN 46158	do	Morgan.
Hydraulic-Press Brick Co	705 Olive St. St. Louis, MO 63101	do	Do.
Log Cabin Coal Co	304 South Depot St. Brazil, IN 47834	Pits	Clay.

See footnotes at end of table.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

[2] Physical scientist, Bureau of Mines, Pittsburgh, Pa.

Table 12.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Gypsum:			
National Gypsum Co.[3]	4100 First International Bldg. Dallas, TX 75270	Underground mine and plant.	Martin.
United States Gypsum Co.[2]	101 South Wacker Dr. Chicago, IL 60606	do	Do.
Lime:			
Inland Steel Co	3210 Watling St. East Chicago, IN 46312	Plant	Lake.
Marblehead Lime Co	300 West Washington St. Chicago, IL 60606	do	Do.
Other metals:			
Aluminum Company of America	Newburgh, IN 47530	Smelter	Warrick.
Federated Metals Corp	2230 Indianapolis Blvd. Whiting, IN 46394	Plant	Lake.
NL Industries, Inc	3700 South Arlington Ave. Beech Grove, IN 46107	do	Marion.
U.S.S. Lead Refinery, Inc	5300 Kennedy Ave. East Chicago, IN 46312	do	Lake,
Peat:			
Etna Green Peat Inc. (Wolff Farms),	9332 South, 150 West Union Mills, IN 46382	Bog and plant	Kosciusko.
Michigan Peat Co	Box 66388 Houston, TX 77006	do	Jasper.
Millburn Peat Co., Inc	Box 236 La Porte, IN 46350	do	La Porte.
Perlite, expanded:			
Chemrock Corp	Box 7151 Nashville, TN 37210	Plant	Tippecanoe.
Grefco, Inc	3450 Wilshire Blvd. Los Angeles, CA 90010	do	Montgomery.
Pig iron and steel:			
Bethlehem Steel Corp	Box 248 Chesterton, IN 46304	Blast furnaces	Porter.
Inland Steel Co	3210 Watling St. East Chicago, IN 46312	do	Lake.
Jones & Laughlin Steel Corp	3001 Dickey Rd. East Chicago, IN 46312	do	Do.
United States Steel Corp	1 North Broadway Gary, IN 46402	do	Do.
Sand and gravel:			
American Aggregates Corp	Drawer 160 Greenville, OH 45331	Pits and plants	Hamilton, Marion, Wayne.
Martin Marietta Aggregates	Box 789 Cedar Rapids, IA 52406	do	Various.
Western Materials Co., a division of Medusa Aggregates Co.[1]	Box 150, 600 Morland Dr. Lafayette, IN 47901	do	Do.
Stone:			
American Aggregates Corp	Box 21247 Indianapolis, IN 46204	Quarries and plants	Hamilton, Marion, Owen.
Irving Bros. Gravel Co., Inc.[4]	3888 Garthwaite Rd. Marion, IN 46952	do	Delaware, Grant, Huntington.
Martin Marietta Aggregates	6340 Castleplace Dr. Box 50815 Indianapolis, IN 46204	do	Madison, Putnam, Vigo.
Mulzer Crushed Stone Co	Box 248 Tell City, IN 47586	Quarries, mine, plants	Crawford and Perry.
Ralph Rogers & Co., Inc.[2] [4]	Box 147 Kentland, IN 47951	Quarries and plants	Lawrence, Monroe, Newton.
Sulfur, recovered elemental:			
Amoco Oil Co	2815 Indianapolis Blvd. Indianapolis, IN 46204	Refinery	Lake.
Energy Cooperative, Inc	3500 Indianapolis Blvd. East Chicago, IN 46312	do	Do.

[1] Also stone.

[2] Also clays.

[3] Also expanded perlite.

[4] Also sand and gravel.

The Mineral Industry of Iowa

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Iowa Geological Survey for collecting information on all nonfuel minerals.

By James H. Aase,[1] Wanda J. West,[2] and Raymond R. Anderson[3]

The value of nonfuel mineral production in Iowa for 1978 and 1979 was $259.6 million and $277.9 million, respectively. The increase in value of production in 1978 over that of the previous year marked the 11th consecutive year that nonfuel mineral production values have increased to new record highs.

Nationally, Iowa ranked 25th among the States in value of nonfuel mineral production for 1978, with production reported from nearly 600 operations located in 97 of the State's 99 counties. Cerro Gordo County continued as the State's leading county in terms of value of nonfuel mineral output. Forty-two counties recorded production valued in excess of $1 million.

Table 1.—Nonfuel mineral production in Iowa[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:						
Masonry thousand short tons	86	$5,052	88	$5,390	69	$3,844
Portland do	2,645	99,383	2,646	107,335	2,371	109,628
Clays do	883	2,461	894	2,694	870	2,883
Gem stones	NA	1	--	--	--	--
Gypsum thousand short tons	1,593	10,035	1,602	12,175	1,695	13,777
Peat do	16	266	6	182	11	270
Sand and gravel do	[2]16,600	[2]33,290	[2]17,670	[2]37,310	17,495	39,686
Stone:						
Crushed do	29,183	76,964	31,310	88,618	32,471	103,215
Dimension do	W	W	10	480	10	508
Combined value of other nonmetals and values indicated by symbol W	XX	4,238	XX	5,376	XX	4,090
Total	XX	231,690	XX	259,560	XX	277,901

NA Not available. W Withheld to avoid disclosing company proprietary data; included with "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes industrial sand; value included in "Combined value" figure.

The State's nonfuel mineral output during 1978 consisted of seven nonmetallic mineral commodities. Portland and masonry cement production ranked first in terms of value, followed by, in descending order, crushed stone, construction sand and gravel, gypsum, and others of lesser value.

The nationwide cement shortage that began developing in 1977 was being felt in the State by mid-1978 when sales of cement had exceeded production capacity and previous yearend stocks had been depleted.

During the biennium 1978-79, cement industry activities in Iowa were highlighted by the completion of an expansion program at the Mason City plant of Lehigh Portland Cement Co.; the start of construction of a new plant, near Davenport, by Martin-Marietta Corp.; and the sale of the Marquette Co. plant in Des Moines.

In March 1979, information was released by the Iowa Geological Survey announcing the discovery of a precambrian taconite body south of Matlock in eastern Sioux County. The Matlock taconite body is described as a deposit of alternating bands of black magnetite and chert, at least 80 feet thick and lying at a depth of about 600 feet below the surface. The taconite body was further described as roughly circular in shape with a diameter of a few miles.

Table 2.—Value of nonfuel mineral production in Iowa, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Adair	W	W	Stone
Adams	W	W	Do.
Allamakee	$480	$757	Stone, sand and gravel.
Appanoose	W	2,864	Stone, clays, sand and gravel.
Audubon	W	W	Sand and gravel.
Benton	W	W	Stone, sand and gravel.
Black Hawk	W	W	Do.
Boone	872	860	Sand and gravel.
Bremer	W	637	Stone, sand and gravel.
Buchanan	W	W	Do.
Buena Vista	281	216	Sand and gravel.
Butler	W	W	Stone, sand and gravel.
Calhoun	71	71	Sand and gravel.
Carroll	400	475	Do.
Cass	W	W	Stone.
Cedar	W	W	Stone, sand and gravel.
Cerro Gordo	W	W	Cement, stone, sand and gravel, clays.
Cherokee	721	372	Sand and gravel.
Chickasaw	W	W	Stone, sand and gravel.
Clarke	429	790	Stone.
Clay	W	230	Sand and gravel.
Clayton	2,763	3,192	Sand and gravel, stone.
Clinton	2,142	1,809	Stone, sand and gravel.
Crawford	W	W	Sand and gravel.
Dallas	671	W	Sand and gravel, clays.
Davis	W	W	Stone.
Decatur	656	703	Do.
Delaware	W	W	Stone, sand and gravel.
Des Moines	W	5,643	Gypsum, stone, sand and gravel.
Dickinson	359	308	Sand and gravel.
Dubuque	W	W	Stone, sand and gravel.
Emmet	320	432	Sand and gravel.
Fayette	1,246	1,272	Stone, sand and gravel.
Floyd	W	773	Do.
Franklin	W	1,098	Stone, sand and gravel, clays.
Fremont	W	561	Stone, sand and gravel.
Greene	463	398	Sand and gravel.
Grundy	27	27	Do.
Guthrie	26	26	Do.
Hamilton	W	W	Stone, sand and gravel.
Hancock	W	1,483	Stone, sand and gravel, peat.
Hardin	4,336	5,040	Stone, sand and gravel.
Harrison	W	W	Do.
Henry	W	244	Do.
Howard	374	W	Do.
Humboldt	W	1,579	Do.
Ida	69	--	
Iowa	--	W	Sand and gravel.
Jackson	W	W	Stone, sand and gravel.
Jasper	W	W	Sand and gravel, stone.
Jefferson	W	W	Stone.
Johnson	W	3,144	Stone, sand and gravel.
Jones	1,832	1,862	Do.
Keokuk	W	W	Stone.
Kossuth	114	156	Sand and gravel.
Lee	W	W	Stone, sand and gravel.
Linn	4,778	6,622	Stone, sand and gravel, peat.
Louisa	W	W	Stone, sand and gravel.
Lucas	24	13	Stone.
Lyon	43	W	Sand and gravel.
Madison	W	W	Stone, clays.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Iowa, by county[1] —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Mahaska	W	W	Sand and gravel.
Marion	W	W	Stone, sand and gravel, gypsum.
Marshall	W	W	Stone, sand and gravel.
Mills	W	W	Stone.
Mitchell	W	W	Stone, sand and gravel.
Monona	W	W	Sand and gravel.
Monroe	W	W	Stone.
Montgomery	W	W	Stone, sand and gravel.
Muscatine	W	W	Do.
O'Brien	$139	$227	Sand and gravel.
Osceola	368	W	Do.
Page	W	W	Sand and gravel, stone.
Palo Alto	324	W	Sand and gravel.
Plymouth	2,139	2,201	Do.
Pocahontas	W	W	Stone, sand and gravel.
Polk	W	W	Cement, sand and gravel, clays.
Pottawattamie	W	W	Stone, sand and gravel.
Poweshiek	W	W	Stone.
Sac	907	W	Sand and gravel.
Scott	30,948	34,051	Cement, stone, lime, sand and gravel, clays.
Shelby	W	W	Sand and gravel.
Sioux	1,362	1,623	Do.
Story	W	1,548	Sand and gravel, stone, clays.
Tama	W	W	Stone, sand and gravel.
Taylor	6	87	Stone.
Union	W	W	Do.
Van Buren	W	W	Stone, sand and gravel.
Wapello	W	W	Sand and gravel, clays.
Warren	W	W	Do.
Washington	W	W	Stone.
Wayne	--	W	Do.
Webster	W	11,601	Gypsum, stone, sand and gravel, clays.
Winnebago	W	W	Sand and gravel, peat.
Winneshiek	1,289	1,640	Stone, sand and gravel.
Woodbury	W	W	Clays, sand and gravel.
Worth	W	1,530	Stone, sand and gravel, peat.
Wright	602	371	Sand and gravel.
Undistributed[2]	170,114	161,026	
Total[3]	231,690	259,560	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Ringgold County is not listed because no nonfuel mineral production was reported.

[2] Includes gem stones (1977), and some sand and gravel that cannot be assigned to specific counties and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Iowa business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	1,388.0	1,425.0	1,432.0	+0.5
Unemployment	do	56.0	57.0	59.0	+3.5
Employment (nonagricultural):					
Mining[1]	do	2.5	2.5	2.5	--
Manufacturing	do	245.6	252.5	258.0	+2.2
Contract construction	do	57.6	61.1	58.2	-4.7
Transportation and public utilities	do	55.0	56.9	58.3	+2.5
Wholesale and retail trade	do	275.4	286.5	286.2	-.1
Finance, insurance, real estate	do	52.6	55.4	57.0	+2.9
Services	do	188.1	196.2	202.8	+3.4
Government	do	202.5	208.2	205.5	-1.3
Total nonagricultural employment[1]	do	[2]1,079.2	[2]1,119.2	[2]1,128.3	+.8
Personal income:					
Total	millions	$19,813	$22,748	$24,925	+9.6
Per capita		$6,861	$7,856	$8,589	+9.3

See footnotes at end of table.

Table 3.—Indicators of Iowa business activity —Continued

	1977	1978	1979^p	1978-79 percent change
Construction activity:				
Number of private and public residential units authorized	20,591	[3]17,161	13,075	-23.8
Value of nonresidential construction millions	$261.9	$279.8	$354.8	+26.8
Value of State road contract awards do	$177.0	$127.0	$139.7	+10.0
Shipments of portland and masonry cement to and within the State thousand short tons	1,791	1,956	1,807	-7.6
Nonfuel mineral production value:				
Total crude mineral value millions	$231.7	$259.6	$277.9	+7.0
Value per capita, resident population	$80	$90	$96	+6.7
Value per square mile	$4,116	$4,611	$4,937	+7.1

[p] Preliminary.

[1] Includes bituminous coal.

[2] Data may not add to totals shown because of independent rounding.

[3] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

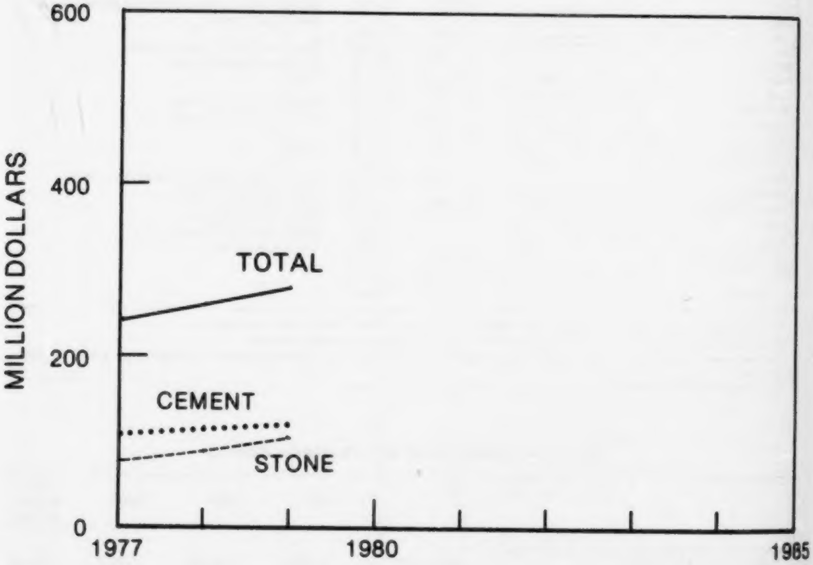

Figure 1.—Value of cement, stone, and total value of nonfuel mineral production in Iowa.

The Aluminum Company of America (Alcoa) announced plans in 1979 to add 11 acres of building space to expand the production capacity of its plant in the Davenport suburb of Riverdale. The plant already is the largest aluminum sheet, plate, and foil rolling mill in the world. The expansion is intended to meet the sharply increasing worldwide demand for heat-treated aluminum in the aerospace and automotive industries. When the expansion project is finished in 3 to 4 years, employment will increase by about 340 workers to a total work force of about 3,540 people.

Alpha Crushed Stone, Inc.'s Lyons quarry at Clinton was the recipient of the "Outstanding Achievement Award" from the National Crushed Stone Association for its effort during 1978 in developing and implementing site beautification plans.

During 1979, Martin-Marietta Aggregates initiated activities to develop two of its limestone properties into underground mining operations. The company is driving a decline at the site of its proposed Waterloo operation and is preparing to start driving an entry into the existing quarry face at its Ferguson property.

During the biennium 1978-79, the Iowa Geological Survey prepared more than two score of reports and publications relating to investigations made on mineral and water resources and the geology of the State. Reports of special interest covering the State's mineral resources included: Gypsum Resources of the Fort Dodge Area, 1978, Public Information Circular No. 9; Matlock Taconite Body, 1979, Open File Report; An Introduction to the Stratigraphic Palynology of the Cherokee Group (Pennsylvanian) Coal of Iowa, 1979, Technical Paper No. 6; and Coal Resource Program Report, 1979.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—The total value of shipments in 1978 increased to a new record high for the eighth consecutive year. Although the quantity produced increased slightly over that of the previous year, it was still less than the record output of 1973. Iowa ranked 9th in the Nation in production of portland cement and 17th in masonry cement output.

Five companies operated 13 kilns at 3 wet-process and 2 dry-process plants. Two companies operated plants located in Mason City, two in Des Moines, and one in Buffalo.

Portland cement shipments increased both in quantity and value in 1978 over that of the previous year. The average value of portland cement sold by the Iowa manufacturers during the year was $40.56 per ton. Ready-mix companies were the largest users of the State's portland cement production, consuming about two-thirds of the output, followed, in descending order, by concrete product manufacturers, highway contractors, building material dealers, and minor amounts to government agencies, and other customers. Most of the shipments were made in bulk, with only minor amounts shipped in containers. Truck transportation was utilized in making the majority of the shipments and rail accounted for the remainder.

Masonry cement shipments in 1978 increased slightly in quantity and value over that of the previous year. The average value of masonry cement sold in 1978 was $61.28 per ton, a $2.84 per ton increase over that sold the previous year.

Approximately 4.4 million tons of nonfuel minerals and related raw materials were consumed in the producton of 2.7 million tons of finished cement in Iowa during 1978.

A $25 million modernization and expansion program was completed at Lehigh Portland Cement Co.'s Mason City plant during 1978. The program, started in late 1976, included the installation of a new 13- by 184-foot coal-fired kiln and support facilities that allow for retirement of six old kilns. Plant capacity was increased about 20% to 750,000 tons per year. Lehigh, a wholly owned subsidiary of the Portland-Zementwerke, Heidelberg A.G. since 1977, also replaced much of its quarry loading, hauling, and crushing equipment, as a part of the modernization program.

The Martin-Marietta Corp. began studies early in 1978 for a proposed new cement plant to replace its existing facility at Buffalo, near Davenport. The studies focused on the size and cost of a dry-process plant with more capacity and greater operating efficiencies than those of the existing 500,000-ton-per-year wet-process plant. Near the end of 1978, the company announced that Kaiser Engineers of Oakland, Calif. had been commissioned to proceed with detailed engineering and procurement phases for the construction of an $80 million, 850,000-ton-per-year plant, slated for completion in late 1980. Groundbreaking and the start of construction occurred in March 1979. The new plant, a four-stage precalcining, dry-process facility, is being designed to produce cement for slightly more than half the energy required by the existing plant, which will continue operating until the new facility is completed.

The Monarch Cement Co. of Humboldt, Kans., purchased the Marquette Co. cement plant in Des Moines in May 1979. Monarch will continue operations at the facility. The Des Moines plant employed 185 persons, including those who operated a quarry in Winterset. The plant makes portland and masonry cements and has an annual capacity of about 370,000 tons.

Clays.—Production of common clay and shale in 1978 increased slightly in both quantity and value over that of 1977. The average value of the clay and shale produced in the State during 1978 was $3.01 per ton, a $0.22 per ton increase over that of the previous year.

Production during 1978 was obtained from 14 mines operated by 11 companies located in 12 counties. Three firms produced nearly two-thirds of the total State output. Cerro Gordo County was the leading county in the State in clay production.

Portland cement manufacturing was the largest user of the clay produced in the State during 1978, consuming 43% of the output. Other uses of the clay, in descending order of amounts consumed, included the manufacturing of building brick, drain tile, lightweight aggregate for concrete block, sewer pipe, and roof tile.

Gypsum.—Production of crude gypsum in 1978 increased both in quantity and value compared to the previous year. The average value of crude gypsum produced during the year was $7.60 per ton, a $1.30 per ton increase over that of 1977.

Nationally, Iowa ranked second among the States in value of crude gypsum production, exceeded only by Michigan. The 1978 output was a new record, surpassing the previous high established in 1977.

During 1978, gypsum was produced by five companies operating seven mines in three counties. Underground mines were operated by United States Gypsum Co. near Sperry in Des Moines County and Kaser Corp. near Harvey in Marion County. Surface mine operations were conducted by United States Gypsum, National Gypsum Co., Georgia-Pacific Corp., and Jim Walter Corp. at sites around Fort Dodge in Webster County. All companies, except Kaser Corp., calcined a portion of their output at plants near the mine sites.

Lime.—Production of lime in 1978 increased sharply in quantity and value over that of the previous year. Linwood Stone Products Co., Inc., in Scott County was the State's sole producer of quicklime and hydrated lime.

The major uses of the output included water purification, water softening, and in steel furnace operations.

Peat.—Four companies produced either moss, humus, or reed-sedge peat from bogs in Hancock, Linn, Winnebago, and Worth Counties. The principal type of peat produced was reed-sedge, which was sold mostly in bulk for use in golf courses. Other uses of the peat were for mixed fertilizers, general soil improvement, potting soils, nurseries, and vegetable growing.

Perlite.—Crude perlite mined in other States was expanded by National Gypsum Co. and United States Gypsum Co. at their Fort Dodge gypsum calcining plants in Webster County during the biennium 1978-79. The entire output was used for plaster aggregate.

Sand and Gravel.—Production of construction sand and gravel in 1978 increased modestly in quantity and value over that of the previous year. The average value of the output was $2.11 per ton. Production was obtained from 226 deposits, operated by 128 companies, located throughout 80 of Iowa's 99 counties. Polk County, number one in the State in terms of population, had the largest output. Six companies, operating from 54 pits, produced more than 500,000 tons each and accounted for about 40% of the total State output.

Quantities of construction sand and gravel obtained from the individual pit operations varied widely. In 1978, approximately 38% of the operations produced less than 25,000 tons; 35% between 25,000 and 100,000 tons; 26% between 100,000 and 500,000 tons; and the remainder between 500,000 and 1,500,000 tons.

The major use of the construction sand and gravel produced was for concrete aggregate which accounted for about half of the total. Other uses included roadbase and coverings, fill, asphaltic concrete, and minor amounts for concrete products, plaster and gunite sands, and snow and ice control.

Table 4.—Iowa: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	7,271	$17,028	$2.34	8,752	$20,312	$2.32	7,820	$19,127	$2.45
Plaster and gunite sands	NA	NA	NA	207	497	2.40	186	664	3.56
Concrete products	554	1,321	2.39	447	1,131	2.53	367	1,009	2.75
Asphaltic concrete	3,189	5,639	1.77	1,856	3,909	2.11	1,970	4,087	2.07
Roadbase and coverings	3,202	6,039	1.89	3,395	6,744	1.99	3,846	7,685	2.00
Fill	2,254	3,050	1.35	2,571	3,757	1.46	2,636	4,059	1.54
Snow and ice control	NA	NA	NA	215	455	2.11	182	535	2.94
Railroad ballast	16	46	2.92	3	7	2.32	10	27	2.68
Other uses	115	166	1.45	224	499	2.23	280	675	2.41
Total[1] or average	16,600	33,290	2.01	17,670	37,310	2.11	17,297	37,867	2.19

NA Not available.

[1] Data may not add to totals shown because of independent rounding.

Table 5.—Iowa: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	8,871	$17,144	$1.93	10,784	$21,486	$1.99	10,278	$21,775	$2.12
Gravel	7,728	16,146	2.09	6,888	15,826	2.30	7,019	16,092	2.29
Total[1] or average	16,600	33,290	2.01	17,670	37,310	2.11	17,297	37,867	2.19
Industrial sand	W	W	W	W	W	W	198	1,819	9.18
Grand total[1] or average	W	W	W	W	W	W	17,495	39,686	2.27

W Withheld to avoid disclosing company proprietary data.

[1] Data may not add to totals shown because of independent rounding.

Table 6.—Iowa: Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1977[1]			1978[1]			1979		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Allamakee	2	16	28	1	1	1	1	18	26
Appanoose	1	100	150	1	100	150	1	W	W
Benton	2	W	W	2	118	198	2	122	209
Black Hawk	7	455	870	7	655	1,243	6	476	1,028
Boone	8	456	872	6	403	860	5	344	686
Bremer	3	29	55	2	W	W	2	W	W
Buena Vista	3	164	281	3	137	216	3	161	217
Calhoun	1	47	71	1	47	71	1	47	71
Carroll	5	222	400	5	229	475	5	202	398
Cerro Gordo	3	218	611	4	341	999	3	228	710
Cherokee	7	323	721	4	159	372	4	244	612
Chickasaw	1	16	32	1	3	6	--	--	--
Clay	2	W	W	3	103	230	3	93	220
Clayton	4	r517	902	6	W	W	4	351	2,157
Clinton	4	155	324	4	149	317	4	150	347
Dallas	5	243	436	4	270	544	4	280	630
Davis	1	100	299	--	--	--	--	--	--
Dickinson	5	214	359	4	198	308	6	176	289
Emmet	3	182	320	4	216	432	4	320	531
Fayette	4	49	91	5	74	127	4	25	67
Floyd	2	W	W	2	54	97	2	100	146
Franklin	6	206	382	4	176	348	3	124	221
Greene	6	268	463	6	224	398	5	250	453

See footnotes at end of table.

Table 6.—Iowa: Sand and gravel sold or used by producers, by county —Continued

(Thousand short tons and thousand dollars)

County	1977[1]			1978[1]			1979		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Grundy	1	9	27	1	9	27	1	12	38
Guthrie	1	10	26	1	10	26	1	W	W
Hamilton	3	42	71	3	35	58	3	57	65
Hancock	7	255	547	9	267	568	7	195	483
Hardin	7	389	656	6	177	352	5	185	349
Howard	1	6	8	2	29	W	2	6	13
Ida	1	46	69	--	--	--	2	W	W
Jones	7	155	258	6	279	538	6	310	815
Kossuth	3	101	114	4	115	156	3	87	93
Linn	4	527	1,030	4	661	1,413	4	595	1,300
Lyon	3	19	43	2	W	W	2	W	W
Marion	4	294	569	6	774	1,742	5	877	1,883
Marshall	5	322	627	3	239	499	3	W	W
Monroe	1	33	132	--	--	--	--	--	--
Muscatine	4	567	1,050	4	639	1,169	4	646	1,164
O'Brien	3	91	139	3	88	227	3	134	338
Osceola	3	202	368	2	W	W	2	W	W
Palo Alto	1	180	324	1	W	W	1	W	W
Plymouth	4	1,312	2,139	3	1,313	2,201	2	W	W
Pocahontas	1	19	29	1	19	29	--	--	--
Polk	7	1,821	4,335	9	2,268	5,490	9	2,119	5,109
Sac	5	445	907	2	W	W	3	W	W
Scott	3	352	863	2	W	W	3	384	925
Sioux	6	735	1,362	7	828	1,623	7	957	1,876
Van Buren	1	92	W	1	106	W	1	96	W
Wapello	1	213	509	1	275	685	1	217	615
Warren	1	35	W	1	W	W	1	W	W
Webster	6	298	601	6	323	698	4	253	600
Winnebago	2	W	W	4	113	190	2	W	W
Winneshiek	1	53	137	1	85	209	1	71	209
Worth	3	252	445	3	262	487	3	213	458
Wright	7	317	602	4	159	371	3	193	400
Undistributed[2]	[r]40	3,426	7,636	45	4,939	11,160	41	6,177	13,935
Total[3]	232	16,600	33,290	226	17,672	37,312	207	17,495	39,686

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Data exclude industrial sand to avoid disclosing company proprietary data.

[2] Includes Audubon, Buchanan, Butler, Cedar, Crawford, Delaware, Des Moines, Dubuque, Fremont, Harrison, Henry, Humboldt, Iowa (1978-79), Jackson, Jasper, Johnson, Lee, Louisa (1978-79), Mahaska, Mitchell, Monona, Montgomery (1978-79), Page, Pottawattamie, Shelby, Story, Tama, and Woodbury Counties, some sand and gravel that cannot be assigned to specific counties, and data indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Industrial sand was produced by Martin-Marietta Aggregates in Clayton County and by Booneville Gravel Co. in Dallas County during 1978. Output was principally for foundry use.

Approximately 90% of all sand and gravel shipments were made by truck.

Stone.—Crushed and dimension limestone were the only types of stone produced in Iowa during the biennium 1978-79. Production was derived from more than 300 quarries located in approximately two-thirds of the State's counties. Scott County was the leading county in crushed stone output during 1978, followed by Cerro Gordo, Madison, Linn, and Black Hawk Counties, respectively. These five counties, which produced more than 1 million tons each and collectively accounted for about one-third of the total State production, are geographically located to best supply the cement manufacturing and construction needs of the urban areas of Davenport, Mason City, Des Moines, Cedar Rapids, and Waterloo.

More than half of the State's crushed stone output was from the operations of 10 firms, each producing quantities in excess of 1 million tons in 1978. Production from the individual quarry operations ranged from less than 25,000 tons to more than 1 million tons. In 1978, 41% of the quarries produced less than 25,000 tons; 33% between 25,000 tons and 100,000 tons; 24% between 100,000 tons and 500,000 tons; and the remainder produced more than 500,000 tons.

Table 7.—Iowa: Crushed limestone sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	2,816	[r]9,225	2,870	8,662	2,806	9,469
Poultry grit and mineral food	12	[r]77	W	W	W	W
Concrete aggregate	[r]3,967	[r]12,976	4,557	16,456	4,189	15,601
Bituminous aggregate	1,542	4,424	1,513	4,573	1,699	5,828
Macadam aggregate	58	115	297	729	193	517
Dense-graded roadbase stone	6,028	[r]15,193	5,792	15,333	6,451	19,988
Surface treatment aggregate	4,366	[r]11,274	5,271	14,612	5,493	17,782
Other construction aggregate and roadstone	4,813	[r]11,873	4,756	13,117	5,589	17,225
Riprap and jetty stone	190	562	246	877	363	1,341
Railroad ballast	893	2,162	1,026	2,533	1,071	2,801
Filter stone	7	25	89	301	98	358
Stone sand	W	W	22	52	W	W
Cement manufacture	3,787	7,044	3,751	6,291	3,362	5,990
Fill	W	W	W	W	86	161
Other uses[1]	[r]705	[r]2,015	1,121	5,081	1,071	6,153
Total[2]	29,183	76,964	31,310	88,618	32,471	103,215

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes stone used in lime manufacture, flux stone, asphalt filler, other filler (1977), soil conditioners (1977), disinfectant (1978-79), roofing granules (1979), sulfur removal from stack gases (1979), other miscellaneous uses, and uses indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 8.—Iowa: Crushed limestone sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1977			1978			1979		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Allamakee	11	192	452	18	300	756	17	446	1,215
Buchanan	[r]14	464	999	13	544	1,393	13	475	1,327
Butler	6	W	W	6	200	452	6	232	614
Cedar	6	W	W	6	282	725	6	346	859
Cerro Gordo	[r]9	2,518	4,836	7	2,227	4,142	6	2,131	4,422
Clarke	1	[r]164	429	1	298	790	1	385	1,101
Clayton	[r]21	[r]551	1,067	19	432	864	12	432	1,023
Clinton	11	718	1,818	11	577	1,492	12	598	1,745
Decatur	3	249	656	3	265	703	4	410	1,176
Delaware	11	389	949	13	469	1,242	13	495	1,253
Dubuque	13	684	1,281	17	895	1,762	13	1,122	2,259
Fayette	[r]21	626	1,155	19	582	1,145	18	628	1,544
Floyd	5	W	W	5	274	676	5	W	W
Franklin	4	237	559	3	W	W	4	209	588
Hancock	2	W	W	3	309	859	3	269	889
Hardin	4	667	3,680	4	726	4,688	4	669	5,115
Harrison	2	W	W	2	208	594	2	265	869
Howard	[r]9	153	366	10	204	546	9	177	494
Humboldt	4	W	W	3	W	W	4	348	1,076
Jackson	10	295	704	8	357	944	8	329	985
Jones	[r]10	[r]508	1,175	10	335	875	10	546	1,609
Lee	4	W	W	4	352	1,090	4	W	W
Linn	[r]11	1,414	3,742	10	1,858	5,204	10	1,563	4,902
Lucas	1	12	24	1	6	13	--	--	--
Madison	9	1,863	5,188	10	2,088	5,435	10	1,837	5,398
Mitchell	6	W	W	5	268	563	8	W	W
Page	1	[r]188	591	1	54	171	1	316	1,082
Scott	5	3,176	7,503	4	2,703	6,711	4	3,261	9,670
Story	2	W	W	2	W	W	1	140	461
Tama	1	299	777	1	W	W	1	204	W
Taylor	1	2	6	2	29	87	1	1	3
Van Buren	5	420	1,269	5	492	1,624	5	549	2,095
Webster	3	545	1,753	3	585	1,972	3	565	2,281
Winneshiek	[r]13	460	1,152	22	547	1,431	19	388	1,116

See footnotes at end of table.

Table 8.—Iowa: Crushed limestone sold or used by producers, by county —Continued

(Thousand short tons and thousand dollars)

County	1977			1978			1979		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Worth	6	315	758	6	336	943	6	339	938
Undistributed[1]	[r]75	[r]12,074	[r]34,080	73	12,505	38,723	72	12,796	45,105
Total[2]	320	[r]29,183	[r]76,964	330	31,310	88,618	315	32,471	103,215

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes Adair, Adams, Appanoose, Benton, Black Hawk, Bremer, Cass, Chickasaw, Davis, Des Moines, Fremont, Hamilton, Henry, Jasper, Jefferson, Johnson, Keokuk, Louisa, Mahaska (1977), Marion, Marshall, Mills, Monroe, Montgomery, Muscatine, Pocahontas, Pottawattamie, Poweshiek, Union, Washington, and Wayne (1978) Counties, and data indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Major uses of the crushed stone production were for dense-graded roadbase stone, surface treatment aggregate, roadstone, concrete aggregate, and cement manufacturing, which accounted for more than three-quarters of the State's output. Most of the crushed stone shipments were handled by truck, with minor amounts shipped by rail and waterway.

Dimension limestone was produced in 1978 by the W. Becker & Sons Stone Co. in Dubuque County and by W.C. Weber Stone Co. in Jones County. The output was used for house stone veneer, dressed construction stone, sawed stone, flagging, rubble, and other purposes.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Lehigh Portland Cement Co.[1 2]	Young Bldg. 718 Hamilton Mall Allentown, PA 18105	Plant	Cerro Gordo.
Marquette Co. Div. of Gulf + Western Industries, Inc.[1 2]	First American Center Nashville, TN 37238	do	Polk.
Martin-Marietta Corp.[1 2]	Box 4288 Davenport, IA 52808	do	Scott.
Northwestern States Portland Cement Co.[1 2]	Box 1008 Mason City, IA 50401	do	Cerro Gordo.
Penn-Dixie Industries, Inc.[2]	Box 152 Nazareth, PA 18064	do	Polk.
Clay and shale:			
Can-tex Industries, Div. of Harsco Corp.	101 Ashworth Rd. Des Moines, IA 50265	Pits and plants	Dallas, Polk, Wapello.
Carter-Waters Corp.	Box 19676 Kansas City, MO 64141	Pit and plant	Appanoose.
W. S. Dickey Clay Manufacturing Co.	Box 6 Pittsburg, KS 66762	do	Webster.
Sioux City Brick & Tile	Box 56 Sergeant Bluff, IA 51054	Pits and plants	Dallas and Woodbury.
Gypsum:			
Celotex Div., Jim Walter Corp.	1500 North Dale Mabry Tampa, FL 33607	Mine and plant	Webster.
Georgia-Pacific Corp	900 SW 5th Ave. Portland, OR 97204	do	Do.
National Gypsum Co.[3]	325 Delaware Ave. Buffalo, NY 14202	do	Do.
United States Gypsum Co.[3]	101 South Wacker Dr. Chicago, IL 60606	Mines and plant	Des Moines and Webster.
Lime:			
Linwood Stone Products Co., Inc.[2]	Route 2 Davenport, IA 52804	Plant	Scott.

See footnotes at end of table.

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[1] State mineral specialist, Bureau of Mines, Twin Cities, Minn.

[2] Program assistant, Bureau of Mines, Twin Cities, Minn.

[3] Chief, Div. of Stratigraphy and Economic Geology, Iowa Geological Survey, Iowa City, Iowa.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Peat:			
C-IT-GRO	Route 2 Garner, IA 50438	Bog and plant	Hancock.
Eli Colby Co	Box 248 Lake Mills, IA 50450	do	Winnebago.
Colby Pioneer Peat Co	Box 8 Hanlontown, IA 50444	do	Worth.
Sand and gravel:			
Acme Fuel & Material Co	Box 34 Muscatine, IA 52761	Pit and plant	Muscatine.
B. L. Anderson, Inc	327 Guaranty Bldg. Cedar Rapids, IA 52401	Pits and plants	Benton, Jones, Linn.
L. G. Everist, Inc	313 South Phillips Sioux Falls, SD 57102	do	Plymouth and Sioux.
G. A. Finley, Inc	Box 465 Harlan, IA 51537	do	Audubon, Crawford, Montgomery, Page, Pottawattamie, Shelby.
Hallett Construction Co	Box 13 Boone, IA 50036	do	Boone, Cherokee, Franklin, Polk, Sac, Story.
Higman Sand & Gravel Co	Akron, IA 51001	Pit and plant	Plymouth.
Kaser Corp	7200 Hickman Rd. Des Moines, IA 50322	Pits and plant	Mahaska and Marion.
Kuhlman Construction Co	Box 126 Colesburg, IA 52035	do	Clayton and Delaware.
Martin-Marietta Aggregates, Central Div.	Box 789 Cedar Rapids, IA 52406	Pits and plants. Industrial sand and construction sand and gravel.	Black Hawk, Clayton, Linn, Marshall, Polk, Wapello.
Maudlin Construction Co	Box 134 Webster City, IA 50595	Pits and plants	Boone, Cerro Gordo, Hardin, Osceola, Plymouth, Warren.
Peters Construction Co	Route 1 Cumming, IA 50061	do	Monona and Polk.
Van Dusseldorp Sand & Gravel, Inc.	Box 156 Colfax, IA 50054	do	Jasper and Marion.
Stone:			
Alpha Crushed Stone, Inc	Box 267 Marion, IA 52302	Quarries and plants	Cedar, Clinton, Dubuque, Jones, Linn.
B. L. Anderson, Inc	327 Guaranty Bldg. Cedar Rapids, IA 52401	do	Benton, Cedar, Jackson, Jones, Linn, Tama.
Kaser Corp	7200 Hickman Rd. Des Moines, IA 50322	do	Des Moines, Fremont, Jasper, Keokuk, Marion, Mills, Monroe, Montgomery, Poweshiek, Washington.
Martin-Marietta Aggregates, Central Div.	Box 789 Cedar Rapids, IA 52406	do	Black Hawk, Bremer, Cerro Gordo, Chickasaw, Hancock, Hardin, Jefferson, Johnson, Keokuk, Linn, Louisa, Madison, Marshall, Story, Worth.
Medusa Aggregates Co	Box 1085 Burlington, IA 52601	do	Des Moines, Jefferson, Lee, Van Buren.
River Products Co	220 Savings & Loan Bldg. Iowa City, IA 52240	do	Johnson, Louisa, Washington.
Schildberg Construction Co., Inc.	Box 358 Greenfield, IA 50849	do	Adair, Adams, Cass, Madison, Pottawattamie, Union.
Weaver Construction Co	Box 817 Iowa Falls, IA 50126	do	Cerro Gordo, Franklin, Hamilton, Hancock, Hardin.
Welp & McCarten, Inc	522 South 22d St., Box W Fort Dodge, IA 50501	do	Black Hawk, Cerro Gordo, Hancock, Howard, Humboldt, Webster, Worth.
Wendling Quarries, Inc	Box 148 Atalissa, IA 52720	do	Cedar, Delaware, Dubuque, Muscatine.

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[1] Also clays.
[2] Also stone.
[3] Also expanded perlite.

The Mineral Industry of Kansas

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the State Geological Survey of Kansas for collecting information on all nonfuel minerals.

By Robert H. Arndt[1] and Carol Zarley[2]

The value of nonfuel minerals produced in Kansas was $230 million in 1978 and rose in 1979 to a record high of $263 million. In perspective, the 1978 value represented an increase of $72 million, or about 46%, above the total value of nonfuel minerals produced in 1975. The surge in mineral value during the intervening years accompanied an economic expansion in Kansas and was supported largely by growth in output, in unit value, and in the total production value of cement, salt, sand and gravel, and stone, which together made up more than 80% of the State's annual total nonfuel minerals value. Mining operations for nonfuel minerals employed 1,200 persons in

Table 1.—Nonfuel mineral production in Kansas[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:						
Masonry__ thousand short tons__	79	$3,742	96	$4,558	89	$4,525
Portland__do____	2,020	72,815	2,083	78,717	2,086	88,619
Clays[2]__do____	1,117	1,965	1,161	2,314	1,061	2,636
Lime__do____	15	409	W	W	W	W
Salt[3]__do____	1,430	41,154	1,661	48,097	1,900	61,184
Sand and gravel__do____	[4]13,973	[4]23,299	[4]14,260	[4]24,330	14,280	26,490
Stone (crushed)[5]__do____	17,229	41,807	18,578	48,803	19,308	56,038
Combined value of clays (bentonite), gypsum, helium (crude and high purity), pumice (1978-79), salt (brine), sand and gravel (industrial, 1977-78), stone (dimension), and values of items indicated by symbol W__	XX	22,627	XX	23,197	XX	23,900
Total__	XX	207,818	XX	230,016	XX	263,392

W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes bentonite; value included in "Combined value" figure.

[3] Excludes salt in brines; value included in "Combined value" figure.

[4] Excludes industrial sand; value included in "Combined value" figure.

[5] Excludes dimension stone; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Kansas, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Allen	W	W	Cement, stone, clays.
Anderson	$340	W	Stone.
Atchison	W	W	Do.
Barber	W	W	Gypsum, sand and gravel.
Barton	1,280	$538	Sand and gravel, clays.
Bourbon	534	862	Stone.
Butler	904	1,361	Do.
Chase	W	W	Do.
Chautauqua	22	W	Do.
Cherokee	W	W	Sand and gravel, stone, clays.
Cheyenne	103	110	Sand and gravel.
Clark	40	40	Do.
Clay	W	W	Stone, sand and gravel.
Cloud	W	W	Sand and gravel, clays, stone.
Coffey	2,517	W	Stone, sand and gravel.
Comanche	13	3	Sand and gravel.
Cowley	3,807	2,120	Stone, sand and gravel.
Crawford	W	W	Stone, clays.
Decatur	104	74	Sand and gravel.
Dickinson	950	W	Stone, sand and gravel.
Doniphan	W	W	Do.
Douglas	W	W	Do.
Edwards	167	156	Sand and gravel.
Elk	2,047	W	Stone.
Ellis	292	363	Sand and gravel, stone.
Ellsworth	W	W	Salt, sand and gravel, clays.
Finney	W	W	Sand and gravel, stone.
Ford	610	579	Sand and gravel.
Franklin	W	W	Stone, clays.
Geary	W	W	Sand and gravel, stone.
Gove	57	57	Sand and gravel.
Graham	47	146	Stone, sand and gravel.
Grant	W	W	Helium, sand and gravel.
Gray	197	194	Sand and gravel.
Greenwood	677	792	Stone.
Hamilton	111	156	Sand and gravel.
Harper	167	160	Do.
Harvey	W	W	Do.
Haskell	140	170	Do.
Hodgeman	66	W	Do.
Jackson	147	125	Stone, sand and gravel.
Jefferson	1,605	2,206	Stone.
Jewell	W	W	Stone, sand and gravel.
Johnson	W	W	Do.
Kearny	332	332	Sand and gravel.
Kingman	48	48	Do.
Kiowa	298	W	Do.
Labette	955	975	Stone.
Leavenworth	999	1,431	Do.
Lincoln	W	W	Stone, sand and gravel.
Linn	439	598	Stone.
Lyon	W	W	Stone, sand and gravel.
McPherson	W	W	Clays, sand and gravel.
Marion	--	909	Stone.
Marshall	W	W	Gypsum, sand and gravel, stone.
Meade	55	W	Sand and gravel.
Miami	464	483	Stone.
Mitchell	--	W	Sand and gravel.
Montgomery	W	W	Cement, stone, clays.
Morris	W	2	Stone.
Morton	W	W	Helium, sand and gravel.
Nemaha	W	W	Stone.
Neosho	W	W	Cement, stone, clays, sand and gravel.
Ness	130	W	Sand and gravel.
Norton	28	W	Sand and gravel, pumice.
Osage	521	173	Stone, sand and gravel.
Ottawa	27	--	
Pawnee	164	130	Sand and gravel.
Phillips	W	33	Do.
Pottawatomie	W	W	Stone, sand and gravel.
Pratt	W	W	Sand and gravel.
Rawlins	40	36	Do.
Reno	W	34,754	Salt, sand and gravel.
Republic	W	W	Sand and gravel.
Rice	W	15,673	Salt, helium, stone, sand and gravel.
Riley	W	W	Stone, sand and gravel.
Rooks	24	24	Sand and gravel.
Rush	W	W	Helium.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Kansas, by county[1] —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Russell	$95	W	Sand and gravel.
Saline	587	$587	Do.
Scott	15	15	Do.
Sedgwick	W	W	Sand and gravel, salt.
Seward	W	330	Sand and gravel.
Shawnee	W	W	Stone, sand and gravel.
Sheridan	102	W	Sand and gravel.
Sherman	510	W	Lime, sand and gravel.
Smith	W	W	Stone.
Stafford	75	W	Sand and gravel.
Stevens	W	18	Sand and gravel.
Sumner	W	W	Do.
Thomas	253	192	Do.
Trego	238	142	Do.
Wabaunsee	W	163	Stone.
Wallace	24	8	Sand and gravel.
Washington	W	W	Sand and gravel, stone.
Wichita	33	33	Sand and gravel.
Wilson	W	W	Cement, stone, clays.
Woodson	W	W	Stone.
Wyandotte	W	W	Cement, sand and gravel, stone.
Undistributed[2]	184,412	162,715	
Total	[3]207,818	230,016	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Brown, Greeley, Lane, Logan, Osborne, and Stanton Counties are not listed because no nonfuel mineral production was reported.

[2] Includes values indicated by symbol W.

[3] Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Kansas business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	1,117.0	1,159.0	1,198.0	+3.4
Unemployment do	45.0	35.0	40.0	+14.3
Employment (nonagricultural):				
Mining[1] do	11.8	12.9	13.8	+7.0
Manufacturing do	172.9	185.9	198.0	+6.5
Contract construction do	45.6	48.1	50.8	+5.6
Transportation and public utilities do	59.3	63.2	65.5	+3.6
Wholesale and retail trade do	211.9	221.4	226.0	+2.1
Finance, insurance, real estate do	43.6	45.0	45.8	+1.8
Services do	149.0	156.2	164.8	+5.5
Government do	176.9	180.0	182.0	+1.1
Total nonagricultural employment[1] do	'871.0	[2]912.5	946.7	+3.7
Personal income:				
Total millions	$16,246	$18,421	$21,451	+16.4
Per capita	$7,003	$7,846	$9,055	+15.4
Construction activity:				
Number of private and public residential units authorized	17,524	[3]15,856	11,974	-24.5
Value of nonresidential construction millions	$238.4	$229.3	$352.0	+53.5
Value of State road contract awards do	$161.9	$136.0	$235.0	+72.8
Shipments of portland and masonry cement to and within the State thousand short tons	1,263	1,267	1,323	+4.4
Nonfuel mineral production value:				
Total crude mineral value millions	$207.8	$230.0	$263.4	+14.5
Value per capita, resident population	$90	$98	$111	+13.3
Value per square mile	$2,526	$2,796	$3,202	+14.5

[p] Preliminary.

[1] Includes bituminous coal and oil and gas extraction.

[2] Data do not add to total shown because of independent rounding.

[3] Series revised in 1978; data not comparable with those of previous years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

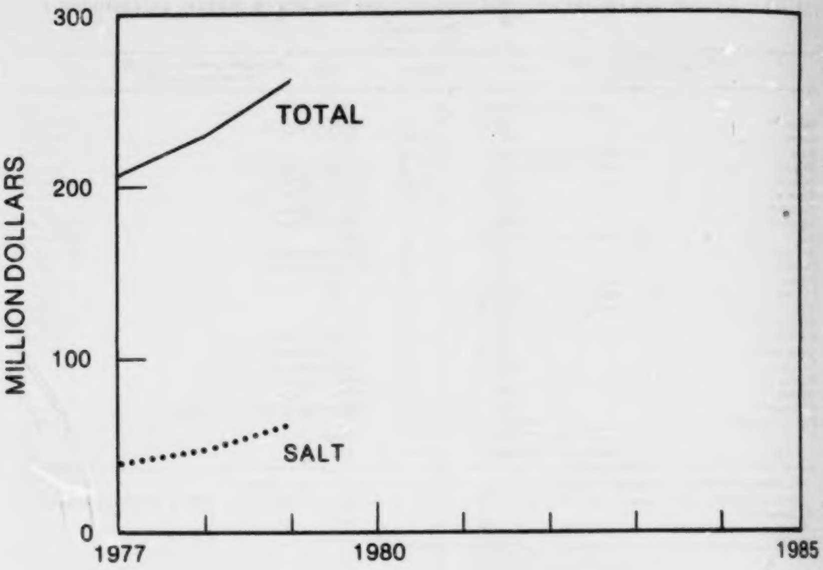

Figure 1.—Value of salt and total value of nonfuel mineral production in Kansas.

1978 and 1,236 persons in 1979, according to the Kansas Department of Human Resources.

Legislation and Government Programs.—Kansas chose the option offered by Public Law 95-87, The Surface Mining Control and Reclamation Act of 1977, to administer the resulting Federal mining regulations for application to the State's own mining industry. During 1978 and 1979, the Kansas Legislature passed several bills that strengthened the State's program for the regulation of surface mining and reclamation in order to meet Federal standards and regulations imposed by the Office of Surface Mining, U.S. Department of the Interior. Senate Bill 897 of 1978 reaffirmed the status of the Mined Land Conservation and Reclamation Board (MLCRB) as an agency under the Kansas Corporation Commission and provided for certain operational functions, including the power to adopt rules and regulations for reclamation as required under Public Law 95-87. Senate Bill 897 established a Federally required system for the issuance of mine permits and brought existing requirements for the grading for surface-mined lands into compliance with Federal standards. In 1979, House Bill 2558 strengthened MLCRB's authority to reclaim abandoned mined lands and to require reclamation of land disturbed by mineral exploration.

Hazardous waste statutes were modified and expanded in 1978 by Senate Bill 170, which authorized the Secretary of Health and Environment to impose certain fees and bonds on firms that are involved in the storage, disposal, and transportation of hazardous wastes; redefined hazardous wastes; and more firmly established the Secretary's jurisdiction over the selection, operation, closing, and termination of hazardous and solid waste disposal sites.

The State Geological Survey of Kansas (KGS) directed part of its energies toward long-range exploration and mining of mineral resources; emphasizing development of new techniques for predicting the potential and quantity of deeply buried mineral deposits; and locating, qualifying, and quantifying mineral resources in Kansas by use of both conventional and newly developing techniques. Objectives included development and utilization of environmentally sound methods for mining and extraction. Studies were started on Mississippi-valley-type zinc-lead deposits, stratiform copper deposits, and the presence and distribution of rare-earth elements in igneous intrusives.

The KGS also investigated properties of the State's mineral resources that might be advantageously utilized by existing or new industries and investigated opportunities for using waste and recycled materials in conjunction with natural materials. Specific research investigated the use of energy conserving construction materials. Investigators probed the causes of deterioration of limestone used in construction and methods of treatment that would inhibit deterioration. The economic potential of Kansas' mineral resources was addressed in annual and biennial mineral industry and producer reports and through an analysis of the State's mineral availability-versus-needs balance begun in 1979. Other ongoing programs investigated the effects of additives in manufacturing ceramic tile and artware bodies from eastern Kansas clays, and the application of glazes formed from Kansas raw materials and commercial frits. Extensive investigations of Kansas water resources sought assurance of an adequate future water supply. The pollution of freshwater aquifers from natural and man-caused invasions by salt brines and other hazardous substances was being evaluated. The U.S. Geological Survey cooperatively supported several water investigations in the State.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Portland cement, a manufactured material, generated more value than any of the nonfuel raw minerals produced in Kansas. Annual increases in the total value of all types of cement produced continued, and in 1979, the total value of cement production rose to more than $93 million. Total production rose similarly, except that shipments peaked in 1978 and dropped off slightly in 1979. A marked increase in the average unit value of shipped portland cement, from about $30 per ton in 1975 to almost $42.50 per ton in 1979, was attributable to inflationary characteristics of the economy and a strong demand for the product. The average unit value of masonry cement increased less abruptly, from about $40.50 per ton in 1975 to about $50.80 per ton in 1979.

Cement was produced in Kansas by five firms; four were located in the southeast in Montgomery, Wilson, Neosho, and Allen Counties; and one was in Wyandotte County near Kansas City. Gray and white portland cements such as general-purpose-moderate-heat, high-early-strength, high-sulfate-resistance, and oil well cement, and prepared masonry cement were manufactured. At the beginning of the 1978-79 biennium, the industry operated 15 kilns with a total production capacity of 7,312 tons of cement per 24 hours. These kilns were served by four glass-bag and eight electrostatic-precipitator air-pollution control devices. In 1978, the industry consumed 3.1 million tons of cement rock and limestone; about 426,000 tons of argillaceous material including both clay and shale; 93,000 tons of siliceous material (sand and sandstone), iron ore, pyrite, and mill scale totaling 6,900 tons as ferriferous material; and about 106,000 tons of gypsum. About the same amounts of individual materials were consumed in 1979. Exclusive of a small quantity of clinker, the industry used 3,755,000 short tons of common raw materials in 1978 and about 3.2% more in 1979. Energy requirements for the industry in 1978 included about 9.6 billion cubic feet of natural gas, less than 100,000 barrels of fuel oil, more than 100,000 tons of bituminous coal, and almost 257 million kilowatt hours of electricity. In 1979, consumption of natural gas and fuel oil was somewhat reduced, but coal and electric power consumption increased. Almost 1.3 million tons of cement was shipped to consumers by truck, approximately 800,000 tons went by rail, and a small increment was transported by other means. Distribution of portland cement to consumers in 1978 included 77.5% to ready-mix companies, 5.9% to concrete products manufacturers, 5.7% to building materials dealers, 4.1% to highway contractors, 4% to other contractors, and 2.9% to miscellaneous consumers. Distribution in 1979 was similar to that of 1978.

Table 4.—Kansas: Portland cement salient statistics

(Short tons)

	1977	1978	1979
Number of active plants	5	5	5
Production	2,072,478	2,063,063	2,117,038
Shipments from mills:			
Quantity	2,019,990	2,083,175	2,086,373
Value	$72,814,839	$78,717,060	$88,619,196
Stocks at mills, Dec. 31	129,913	112,661	136,981

Table 5.—Kansas: Masonry cement salient statistics

(Short tons)

	1977	1978	1979
Number of active plants	5	5	5
Production	69,635	102,531	87,942
Shipments from mills:			
Quantity	79,377	96,269	88,798
Value	$3,741,745	$4,557,848	$4,525,476
Stocks at mills, Dec. 31	8,270	14,618	13,812

Clays.—Common clay and shale and a small increment of bentonite were obtained from mines in 11 counties in the State. The value of clay mined reached a record high of $2.6 million in 1979. Annual increases in the value of clay mined were recorded almost continuously since 1970, when the value was $946,000. Contrastingly, annual output of clay exceeded that of 1979 six times during the decade; only the output of 1970 and 1971 was lower. The average unit value of clay likewise reached a maximum of about $2.48 per ton in 1979 after a steady growth from the lowest value of the decade, $1.25 per ton, which was recorded in 1972.

More than 60% of the common clay and shale mined in the State was mined in six southeastern counties. Of these, Allen, Neosho, and Wilson each yielded more than 250,000 tons in 1978; and Cherokee, Crawford, and Montgomery were the sources of 100,000 to 250,000 tons each. Production from Barton, Ellsworth, and McPherson Counties in central Kansas was also an appreciable part of the State's output. Bentonite was mined in Woodson County. Clay was also produced in two isolated counties, Cloud in the north-central part of the State, and Franklin in the east-central part of the State. Each of the counties, with the exception of Woodson, supported one or more clay manufacturing industries. Almost 40% of the clay produced in Kansas was used in the manufacture of portland cement. More than 25% of the clay was used for brick. Concrete block and structural concrete products required almost 20% of the produced clay. Clay was also used in the manufacture of pottery, sewer pipe, waterproof sealant, highway surfacing, and other items. Animal feeds and fertilizers were manufactured from bentonite at Chanute in Neosho County. Plants for the manufacture of clay products were situated in the counties where clay was produced. Brick and cement were manufactured at Humboldt in Allen County. Weir in Cherokee County had a brick plant. Sewer pipe, drain tile, and similar conductors were manufactured at Pittsburg in Crawford County. Cement was prepared at Independence in Montgomery County and Chanute in Neosho County. Cement and brick were manufactured at Fredonia in Wilson County. Industries at Hoisington in Barton County, Kanopolis in Ellsworth County, and Concordia in Cloud County manufactured brick. Shale was expanded in plants at Ottawa in Franklin County and at Marquette in McPherson County.

Gypsum.—The State's output of crude gypsum continued to rise into the 1978-79 biennium as it had in several previous years. Production of crude gypsum in 1979 was about 50% greater than that reported in 1975. Georgia Pacific Corp. at Blue Rapids and National Gypsum Co. at Medicine Lodge mined and calcined gypsum and manufactured plasters, wallboard, lath, and other gypsum products.

Helium.—The output of crude helium declined in 1978 after having risen annually from 1975 to 1977. It increased subsequently in 1979 to more than twice the output in 1975. Production of high-purity helium continued to rise through 1978, but the trend was reversed in 1979. The values of both crude and high-purity helium followed the respective production trends. Helium was recovered from natural gas in Grant, Morton, Rice, and Rush Counties. Union Carbide Co. started construction of the world's largest helium liquefying plant at Bushton in Rice County in July 1978 and placed it onstream in December 1979. Linde Div. of Union Carbide Corp. planned to produce 300 million cubic feet of 100%-pure liquid helium annually from 80%-pure helium supplied by the adjoining plant of Northern

Natural Gas Co.

Lime.—Great Western Sugar Co. prepared quicklime for manufacturing sugar at its beet sugar plant near Goodland in Sherman County. In the first year of the biennium, output was lower than in any year since 1975.

Perlite.—Lite-Weight Products, Inc., Kansas City, processed perlite obtained from out-of-State sources at its plant in Wyandotte County. The product was used principally in the preparation of horticultural aggregates, as insulation, and as a filter aid.

Pumice.—Calvert Mines, Inc., mined and processed pumicite at Calvert in Norton County in 1978 and 1979. This activity reestablished the pumice industry in Kansas after a lapse of two years. Eighty-seven percent of the processed pumicite was used in the manufacture of cleaning compounds, and the remainder was used in other abrasive materials.

Salt.—Salt output reached 1.9 million tons in 1979, culminating a series of annual increases that began in 1976, when 1.3 million tons was produced. The value of salt production rose correspondingly from $35.3 million to $61.2 million, and the average unit price of salt in Kansas rose from a little over $26.9 per ton in 1976 to $32.2 per ton in 1979. At the beginning of the biennium, six firms were mining salt with operations in four counties in central Kansas. Independent Salt Co. produced bulk rock salt at Kanopolis in Ellsworth County. Both evaporated salt and bulk rock salt were produced by American Salt Corp. at Lyons in Rice County. Carey Salt Co., Cargill, Inc., and Morton Salt Div. of Morton Norwich Products, Inc., mined salt and prepared evaporated salt, pressed blocks of evaporated salt, and bulk rock salt at Hutchinson in Reno County. Vulcan Materials Co. produced brine in Sedgwick County. Producers used both mechanical mining and solution mining to recover salt from the underground salt beds. Salt is widely used as a food additive, preservative, raw material for the chemical industry, recharging agent in water softening, and a deicing agent for winter highways. The closing of some salt mines elsewhere in the United States during 1978-79 increased the demand for Kansas salt essentially to the producing capacity of existing facilities. The heavy demand for Kansas salt from outside the State was manifest in an insufficiency of the material in many areas in Kansas for deicing streets and highways during the winters of 1978-79 and 1979-80.

Sand and Gravel.—The upward trend in both the output and value of sand and gravel that was manifest in previous years continued through the biennium as output in 1979 exceeded 14 million tons valued at more than $26 million. Thus, sand and gravel ranked third in value among the raw nonfuel minerals produced in Kansas. The effects of inflation on the value of sand and gravel were reflected in the average unit values determined by the Bureau of Mines. In 1975, processed construction sand in Kansas had an average value of $1.20 per ton. It rose to about $1.75 per ton in 1979. Industrial sand valued at $3.55 per ton in 1975 had an average value of about $8.70 per ton in 1979.

Sand and gravel was recovered in 73 counties. Counties that border major streams where sand and gravel is available in streambeds and flood plains and along which many of the State's principal cities are situated commonly had vigorous sand and gravel industries. Some of the principal cities of the Arkansas River Valley are Wichita, Hutchinson, Great Bend, Larned, Kinsley, Dodge City, and Garden City. Kansas City, Lawrence, Topeka, Manhattan, and Junction City are adjacent to the Kansas River. Several smaller cities are adjacent to the Big Blue, Republican, Saline, and Smoky Hill Rivers, which are all part of the Kansas River system. Some of the deposits of western Kansas, however, lie within bedded sands and gravels of ancient stream systems, thereby providing deposits in uplands and interstream areas. In the Arkansas River watershed, sand and gravel was recovered in 14 counties that accounted for nearly 40% of the total State output. More than 25% of the State's total output was obtained from the Kansas River between the mouth of the Republican River and Kansas City, and its tributaries, the Big Blue and Republican Rivers. Wyandotte and Sedgwick Counties, each with production of more than 2 million tons of sand and gravel, were the State's leading sources of sand and gravel during the biennium. Production of more than 500,000 tons was recorded individually in Cherokee, Cowley, Reno, and Shawnee Counties both years. More than 135 firms produced sand and gravel from a total of about 170 deposits in the State. Fifteen firms each produced more than 250,000 tons of sand and gravel and together accounted for about half the State's production. The maximum output of an individual firm was about 1.25 million tons in one year.

Sand and gravel was used in two major ways, as fine and coarse aggregate in construction, or as sand required for industrial functions. Almost 50% of the output of construction aggregate was used in cement concrete and asphalt concrete. Sand and gravel used for roadbase, fill, and concrete products, combined with that used in bulk concrete, accounted for almost 95% of the construction aggregate. Industrial sand and gravel was used mainly for the manufacture of fiberglass, for sand blasting, as traction (engine) sand, and for making molds and cores for casting metals. Industrial sand was produced only in Wyandotte and Republic Counties. The relatively low unit value and large consumption of sand and gravel dictate that it be mined as close to the point of consumption as possible. Thus, almost 95% of the State's sand and gravel was transported relatively short distances by truck. The remainder was transported by railroad or used at the point of source. Wyandotte and Cherokee Counties were the sources of most rail-transported sand.

Stone.—Production of stone in Kansas, continuing an increasing trend that began in the mid-1970's, reached 19.3 million tons in 1979. The total value of stone production also increased in the same period to $56 million, and the average unit value of all crushed and broken stone rose from $2.21 per ton in 1975 to more than $2.90 per ton in 1979. The value of produced stone was greater than that of any other raw nonfuel mineral and ranked second after the value of cement, a manufactured material. Limestone, the most widely used stone, was quarried for crushing and for dimension stone. Sandstone, a very minor part of the State's total stone production, was crushed and broken.

Stone was quarried in 50 counties, of which 47 yielded only limestone. Graham, Lincoln, and Smith Counties yielded only sandstone; and Neosho County provided sandstone and limestone. Quarrying was

Table 6.—Kansas: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	4,732	$8,929	$1.89	4,995	$9,347	$1.87	4,305	$8,637	$2.01
Plaster and gunite sands	NA	NA	NA	57	126	2.21	63	120	1.92
Concrete products	1,150	2,549	2.22	1,051	2,321	2.21	788	1,704	2.16
Asphaltic concrete	1,698	3,020	1.78	2,017	3,678	1.82	2,422	4,561	1.88
Roadbase and coverings	3,388	5,296	1.56	2,827	4,546	1.61	2,873	4,759	1.66
Fill	2,302	2,443	1.06	2,456	2,966	1.21	2,729	3,459	1.27
Snow and ice control	NA	NA	NA	135	275	2.04	154	355	2.30
Railroad ballast	W	W	W	331	497	1.50	331	497	1.50
Other uses	703	1,063	1.51	388	573	1.48	419	689	1.65
Total[1] or average	13,973	23,299	1.67	14,260	24,330	1.71	14,084	24,780	1.76

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."
[1] Data may not add to totals shown because of independent rounding.

Table 7.—Kansas: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	9,184	$15,217	$1.66	9,552	$16,213	$1.70	9,618	$17,052	$1.77
Gravel	4,789	8,082	1.69	4,705	8,116	1.72	4,466	7,728	1.73
Total[1] or average	13,973	23,299	1.67	14,260	24,330	1.71	14,084	24,780	1.76
Industrial sand	W	W	W	W	W	W	196	1,710	8.72
Grand total or average	W	W	W	W	W	W	14,280	26,490	1.86

W Withheld to avoid disclosing company proprietary data.
[1] Data may not add to totals shown because of independent rounding.

Table 8.—Kansas: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	430	897	576	1,335	767	2,000
Agricultural marl and other soil conditioners	--	--	--	--	7	24
Concrete aggregate (coarse)	[r]2,815	[r]8,907	3,535	11,738	3,540	12,940
Bituminous aggregate	2,387	6,453	2,264	6,899	2,593	9,095
Macadam aggregate	308	431	328	663	520	1,093
Dense-graded roadbase stone	2,812	6,343	2,712	6,331	3,420	9,738
Surface treatment aggregate	1,140	3,184	1,339	3,890	836	2,500
Other construction aggregate and roadstone	3,265	7,421	3,391	8,357	3,432	9,378
Riprap and jetty stone	150	414	206	649	114	440
Railroad ballast	215	645	169	636	104	542
Filter stone	78	222	104	327	88	303
Manufactured fine aggregate (stone sand)	59	175	122	348	36	127
Cement manufacture	3,328	6,196	3,565	7,016	3,690	7,544
Lime manufacture	--	--	--	--	W	3
Asphalt filler	--	--	W	15	W	208
Other uses[2]	241	519	266	599	160	104
Total[3]	17,229	41,807	18,578	48,803	19,308	56,038

[r] Revised. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Includes limestone and sandstone.

[2] Includes stone used in terrazzo, exposed aggregate, fill, roofing granules (1979), unspecified uses, and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

concentrated in the eastern half of the State, where many limestone strata of usable quality are near urban areas that require large quantities of stone for construction purposes. The distribution of limestone quarrying activities crudely defined three geographic belts, the counties adjacent to the eastern boundary of the State, a belt that extends from the southern boundary in Cowley County northward into Clay and Pottawatomie Counties, and a third less clearly defined belt that extends northward from Rice County to Jewell County on the northern border of the State. Production of more than 500,000 tons of stone per year was achieved in each of the five counties around the Kansas City, Lawrence, and Topeka metropolitan areas and in seven counties in the southeastern part of the State, where most of the cement industry is concentrated. Jefferson, Johnson, Leavenworth, Shawnee, and Wyandotte Counties in the Kansas City-Topeka region yielded more than 30% of the State's stone output. Allen, Butler, Coffey, Elk, Montgomery, Neosho, and Wilson Counties yielded almost 30% of the stone output.

More than 60 firms operated more than 180 quarries in 1978 and 1979. Output of individual firms ranged from about 300 tons per year to almost 2.5 million tons per year. The combined output from 10 firms, each of which produced more than 500,000 tons of stone per year, accounted for more than half the State's annual output. More than half the stone produced was used as aggregate. About 20% was used for the manufacture of cement in five plants in Kansas and in one plant in southern Nebraska. The largest nonconstruction use of crushed stone was for agricultural limestone, which took less than 5% of the product. In 1978, only two firms supplied dimension stone; it was used for cutting and sawing and for house veneer. The sources of limestone used for dimension stone were in Chase, Cowley, Pottawatomie, and Riley Counties. More than 95% of the State's stone was shipped by truck. Railroads transported less than 3%, and only a very minute fraction was moved by barge on the Missouri River.

Sulfur.—Elemental sulfur was recovered in refinery operations by Getty Refining and Marketing Co. in Butler County; CRA, Inc., in Montgomery County; and Phillips Petroleum Co. in Wyandotte County.

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[1] State mineral specialist, Bureau of Mines, Denver, Colo.

[2] Mineral economist, State Geological Survey of Kansas, Lawrence, Kans.

Table 9.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ash Grove Cement Co.[1] [2]	920 Main St. Suite 1000 Kansas City, MO 64105	Plant and quarry	Neosho.
General Portland, Inc., Victor Div.[2]	7701 East Kellogg St. Wichita, KS 67207	do	Wilson.
Lone Star Industries, Inc.[2]	2511 East 46th St. Indianapolis, IN 46205	do	Wyandotte.
The Monarch Cement Co.[1] [2]	Box 187 Humboldt, KS 66748	do	Allen.
United States Steel Corp., Universal Atlas Cement Div.[1] [2]	600 Grant St. Pittsburgh, PA 15230	do	Montgomery.
Clays:			
Cloud Ceramics	Box 98 Concordia, KS 66901	Mines and plant	Cloud.
W. S. Dickey Clay Manufacturing Co	Box 6 Pittsburg, KS 66762	Pits and plant	Cherokee and Crawford.
Excelsior Brick Corp	Box 32 Fredonia, KS 66736	do	Wilson.
Justin Industries, Inc., Acme Brick Co.	Box 425 Fort Worth, TX 76101	Mines and plants	Cherokee and Ellsworth.
Micro-Lite, Inc	1100 South Katy St. Chanute, KS 66720	Pit	Neosho.
Gypsum:			
Georgia-Pacific Corp	900 SW. 5th Ave. Portland, OR 97204	Mine and plant	Marshall.
National Gypsum Co	325 Delaware Ave. Buffalo, NY 14202	do	Barber.
Helium:			
Alamo Chemical Co	Ashfield, KS 67953	Plant	Morton.
Cities Service Cryogenics, Inc	Route 3 Scott City, KS 67871	do	Scott.
Kansas Refined Helium Co	Otis, KS 67565	do	Rush.
Northern Helex Co	Bushton, KS 67427	do	Rice.
Union Carbide Corp., Linde Div.	do	do	Do.
Lime:			
Great Western Sugar Co	Box 5308 Denver, CO 80217	do	Sherman.
Perlite, expanded:			
Lite Weight Products, Inc	707 Funston Rd. Kansas City, KS 66115	do	Wyandotte.
Salt:			
American Salt Corp	3142 Broadway Kansas City, MO 64111	Wells and underground mine.	Rice.
Interpace Corp., Carey Salt Co	1800 Carey Blvd. Hutchinson, KS 67501	do	Reno.
Morton Salt Co.	110 North Wacker Dr. Chicago, IL 60606	Wells	Do.
Vulcan Materials Co., Chemical Div	Box 7689 Birmingham, AL 35223	do	Sedgwick.
Sand and gravel:			
Bingham Sand and Gravel Co	2005 East Ave. Baxter Springs, KS 66713	Pits and plants	Cherokee.
Builders Sand Co	78th & Holliday Dr. Kansas City, KS 66106	Dredge and plant	Johnson and Wyandotte.
Consumers Sand Co., Inc	924 West Railroad St. Topeka, KS 66608	do	Shawnee.
Dodge City Sand Co	Box 430 Dodge City, KS 67801	Pit and plant	Ford.
Holliday Sand and Gravel Co	6811 West 63d St. Overland Park, KS 66202	Dredges and plants	Wyandotte.
Kershaw Ready-Mix Concrete & Sand	Box 668 Manhattan, KS 66502	Dredge, pit, and plant	Riley.
Miles Sand Inc	4857 North Meridian Wichita, KS 67204	Pit and plant	Sedgwick.
Ritchie Sand Co	6500 West 21st St. Wichita, KS 67204	do	Do.
J. H. Shears & Sons, Inc.[2]	819 West 1st St. Hutchinson, KS 67501	do	Reno.
Siebert Sand Co., Inc.[2]	Box 10 Ness City, KS 67560	Dredges and plants	Decatur, Ness, Phillips, Sherman, Thomas, Trego.
Smith Sand Co	Box 391 Garden City, KS 67846	Pit and plant	Finney.
Stone:			
Ashland Oil Co., Reno Construction Co., Inc.	Box 4278 Overland Park, KS 66204	Quarries and plants	Bourbon, Johnson, Miami, Woodson.
Beatrice Foods Co., Thompson Strauss Quarries.	7000 Holliday Dr. Kansas City, KS 66106	Quarry and plant	Wyandotte.

See footnotes at end of table.

Table 9.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Blacktop Construction Co., Inc	Box 549 Emporia, KS 66801	Quarry and plant	Chase, Coffey, Greenwood.
Hallett Construction Co	Box 269 Marion, KS 66861	do	Dickinson, Marion, Rice.
N. R. Hamm Quarries, Inc	Box 425 Herington, KS 67449	do	Various (13 counties).
Holland Quarries, Inc.	Box 5283 Lenexa, KS 66215	Mines and plants	Johnson.
Killough-Clark, Inc	Box 623 Ottawa, KS 66067	Quarries and plants	Anderson, Douglas, Franklin, Miami, Osage.
Lone Star Industries, Inc.	1968 Johnson Dr. Shawnee Mission, KS 66205	Quarry and plant	Wyandotte.
Martin-Marietta Corp	11300 Rockville Pike Rockville, MD 20852	Quarries and plants	Various (13 counties).
Midwest Minerals, Inc	Box 412 Pittsburg, KS 66762	do	Cherokee, Crawford, Labette, Montgomery, Neosho, Wilson.
Quartzite Stone Co., Inc	Box 482 Concordia, KS 66901	do	Lincoln.
Sulfur (byproduct):			
CRA, Inc	3315 North Oak Trafficway Kansas City, MO 64116	Secondary recovery	Montgomery.
Phillips Petroleum Co	Bartlesville, OK 74003	do	Wyandotte.
Getty Refining & Marketing Co.	Box 1121 Eldorado, KS 67042	do	Butler.

[1] Also clays.

[2] Also stone.

[illegible]

[illegible]

The Mineral Industry of Kentucky

By Donald K. Harrison[1] and Preston McGrain[2]

The value of Kentucky's nonfuel mineral production in 1978 and 1979 was $191.3 million and $207.9 million, respectively. Stone continued as the leading nonfuel mineral commodity produced, accounting for 56% of the State's total nonfuel mineral value. Other commodities produced were cement, clays, sand and gravel, and lime. Small quantities of zinc and lead were produced as a byproduct of the fluorspar industry in 1978. Commodities imported for processing included perlite and vermiculite. In 1979, the State ranked fourth in the Nation in production of primary aluminum. During the biennium, output of construction materials (sand and gravel, stone, and cement) was above 1977 levels, primarily because of increased construction activity in the State.

Trends and Developments.—Cominco American Corp. continued to explore promising zinc-bearing formations in south-central Kentucky. After extensively evaluating mineral deposits and national economic conditions, the company will determine whether development is feasible. Although local groups are optimistic about the development of a large mining complex in this area, company officials have taken a more cautious view.

ASARCO Inc. has indefinitely postponed previously announced plans to build a $100 million zinc refinery complex near Stephensport, in Breckinridge County, mainly because of environmental constraints and increased operating costs.

Anaconda Aluminum Co. completed an $80 million addition to its aluminum reduction plant at Sebree. However, most aluminum producers curtailed expansion plans, even though existing facilities were operating at near-peak capacity.

Table 1.—Nonfuel mineral production in Kentucky[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2] .... thousand short tons..	716	$2,500	676	$2,672	794	$3,259
Gem stones	--	--	NA	1	NA	1
Sand and gravel .. thousand short tons..	9,764	19,686	[3]13,180	[3]23,900	[3]11,726	[3]23,721
Stone (crushed) ....do.....	36,096	88,941	40,772	107,949	W	W
Zinc .... metric tons..	--	--	52	35	--	--
Combined value of cement, ball clay, fluorspar (1977-78), lead (1978), lime, sand and gravel (industrial, 1978-79), and values indicated by symbol W.....	XX	45,478	XX	56,790	XX	180,946
Total	XX	156,605	XX	191,347	XX	207,927

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes ball clay; value included in "Combined value" figure.

[3] Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Kentucky, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Adair	W	W	Stone.
Allen	W	W	Do.
Anderson	W	W	Do.
Ballard	$4	--	
Barren	W	W	Stone.
Boone	W	W	Sand and gravel, stone.
Bourbon	W	W	Stone.
Boyle	W	W	Do.
Breckinridge	W	W	Sand and gravel, stone.
Bullitt	W	W	Stone, clays.
Butler	W	W	Stone.
Caldwell	W	W	Do.
Calloway	123	$117	Sand and gravel.
Carlisle	W	W	Clays, sand and gravel.
Carroll	--	2,053	Sand and gravel.
Carter	W	W	Stone, clays.
Casey	W	374	Stone.
Christian	2,658	4,899	Do.
Clinton	W	W	Do.
Crittenden	W	W	Stone, fluorspar, lead, zinc.
Cumberland	W	W	Stone.
Daviess	2,005	2,020	Sand and gravel.
Edmonson	W	W	Stone.
Estill	316	503	Do.
Fayette	W	W	Do.
Fleming	W	W	Do.
Floyd	W	W	Sand and gravel.
Franklin	W	W	Stone.
Fulton	140	147	Sand and gravel.
Gallatin	297	W	Do.
Garrard	W	372	Stone.
Graves	W	W	Clays, sand and gravel.
Grayson	W	W	Stone.
Green	W	W	Do.
Hancock	W	314	Clays.
Hardin	2,493	3,531	Stone.
Harlan	791	879	Do.
Harrison	W	W	Do.
Hart	W	W	Sand and gravel, stone.
Henderson	378	W	Sand and gravel.
Henry	W	W	Stone.
Hickman	W	--	
Jackson	232	223	Stone.
Jefferson	27,855	31,782	Cement, stone, sand and gravel, clays.
Jessamine	W	W	Stone.
Laurel	95	--	
Lee	W	W	Stone.
Letcher	3,209	3,607	Do.
Lewis	W	W	Sand and gravel.
Livingston	21,043	W	Stone, sand and gravel.
Logan	W	W	Stone.
McCracken	263	W	Sand and gravel.
McCreary	--	W	Do.
Madison	W	W	Stone.
Marion	198	241	Do.
Martin	500	155	Sand and gravel.
Mason	W	W	Lime, stone, sand and gravel.
Meade	W	W	Stone.
Menifee	W	W	Do.
Mercer	W	W	Do.
Metcalfe	246	228	Do.
Monroe	359	464	Do.
Montgomery	W	W	Do.
Morgan	W	W	Do.
Muhlenberg	W	W	Do.
Nelson	W	W	Do.
Nicholas	326	132	Do.
Ohio	W	W	Do.
Oldham	2,949	W	Sand and gravel, stone.
Pendleton	W	W	Lime, stone.
Pike	W	W	Stone.
Powell	617	1,835	Stone, clays.
Pulaski	1,720	3,213	Stone.
Rockcastle	W	W	Do.
Rowan	W	--	
Scott	W	W	Stone.
Simpson	W	W	Do.
Spencer	W	--	
Taylor	W	W	Stone.
Todd	W	W	Do.
Trigg	W	W	Do.
Trimble	1,922	--	
Union	W	W	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Kentucky, by county[1] —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Warren	W	W	Stone.
Washington	W	W	Stone.
Wayne	W	W	Stone, sand and gravel.
Wolfe	W	$433	Stone.
Undistributed[2]	$85,862	133,826	
Total[3]	156,695	191,347	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] The following counties are not listed because no nonfuel mineral production was reported: Bath, Bell, Boyd, Bracken, Breathitt, Campbell, Clark, Clay, Elliott, Grant, Greenup, Hopkins, Johnson, Kenton, Knott, Knox, Larue, Lawrence, Leslie, Lincoln, Lyon, McLean, Magoffin, Marshall, Owen, Owsley, Perry, Robertson, Russell, Shelby, Webster, Whitley, and Woodford.

[2] Includes gem stones and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Kentucky business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	1,512.0	1,551.0	1,563.0	+2.6
Unemployment	do.	70.0	82.0	87.0	+6.1
Employment (nonagricultural):					
Mining[1]	do.	48.6	52.1	54.8	+5.2
Manufacturing	do.	284.9	292.2	295.2	+1.0
Contract construction	do.	58.4	68.2	70.2	+2.9
Transportation and public utilities	do.	64.6	67.2	70.1	+4.3
Wholesale and retail trade	do.	247.6	264.3	269.4	+1.9
Finance, insurance, real estate	do.	46.3	48.8	50.3	+3.1
Services	do.	185.9	196.8	204.3	+3.8
Government	do.	212.0	220.3	230.3	+4.5
Total nonagricultural employment[2]	do.	1,148.3	1,209.9	[2]1,244.9	+2.9
Personal income:					
Total	millions	$20,680	$23,106	$25,896	+12.1
Per capita		$5,964	$6,605	$7,342	+11.2
Construction activity:					
Number of private and public residential units authorized		17,960	[3]16,112	13,427	-16.7
Value of nonresidential construction	millions	$221.6	$184.3	$219.9	+19.3
Value of State road contract awards	do.	$371.0	$185.0	$240.0	+29.7
Shipments of portland and masonry cement to anu within the State	thousand short tons	1,284	1,363	1,347	-1.2
Nonfuel mineral production value:					
Total crude mineral value	millions	$156.6	$191.3	$207.9	+8.7
Value per capita, resident population		$45	$55	$59	+7.3
Value per square mile		$3,877	$4,736	$5,147	+8.7

[p] Preliminary.

[1] Includes bituminous coal and oil and gas extraction.

[2] Data do not add to total shown because of independent rounding.

[3] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Western Steel International Corp. and Intercontinental Metals Corp. planned to build a $30 million steel mill near Calvert City in Marshall County. This complex, which would be on a 350-acre site along the Tennessee River, will have a capacity of 250,000 tons per year. The mill is expected to begin operations in 1981 and employ about 600 persons.

In July 1979, SKW Trostberg, a West German company with ferroalloy plants in Germany and Canada, bought the Airco, Inc., ferroalloy plants at Calvert City.

Legislation and Government Programs.—The Kentucky Legislative Research Commission gathered mineral production data and held hearings on the possibility of amending the Coal Severance Tax Act to include all minerals. Legislation expected to be introduced during the 1980 session would impose severance taxes on all mineral resources.

During the period, the Secretary of the Interior designated the University of Kentucky as a State Mining and Mineral Resources and Research Institute pursuant to Title III of Public Law 95-87. The university was selected to establish training programs in mining and minerals extraction and will receive annual allotments through 1984. The school initially received a basic grant of $110,000, plus $160,000 for scholarships and fellowships.

The Kentucky Geological Survey and the Institute for Mining and Minerals Research, two research arms of the University of Kentucky, conducted a joint investigation on the availability of carbonate rock resources in Kentucky for coal-producing and coal-consuming industries. Limestone is utilized by these industries for environmental control measures. Increased coal use to meet energy requirements is expected to require more limestone for rock dust in mines, surface reclamation, acid-drainage control, and flue gas desulfurization.

During 1978, the Kentucky Department of Transportation conducted field and laboratory investigations of highly indurated sandstones for use as roadbase in the eastern part of the State, where limestone is not available. Use requirements dictated that the material be close to the point of consumption and have certain physical properties.

In 1977, the Forest Service of the U.S. Department of Agriculture initiated its Roadless Area Review and Evaluation (RARE II) program. The program identified roadless and undeveloped land areas in the National Forest System suitable for wilderness use. In 1978, three areas were evaluated. Red River Gorge (11,115 acres) was nominated for wilderness use. The Department also proposed that 3,225 acres of the Cave Creek Area in Pulaski and McCreary Counties be designated as nonwilderness, and recommended additional studies for 2,943 acres in the Big South Fork National River and Recreation Area along the Tennessee border in McCreary County.

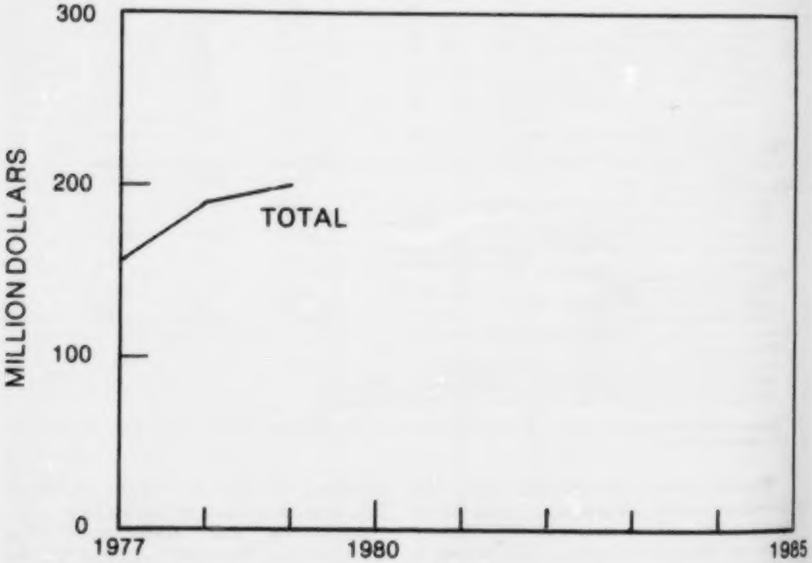

Figure 1.—Total value of nonfuel mineral production in Kentucky.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—The Flintkote Cement Co., the only cement producer in the State, operated the Kosmosdale cement plant in Jefferson County. Most of the cement was used for ready-mix purposes; concrete product manufacturers, building material dealers, and highway contractors consumed the remainder. Raw materials used included limestone, clay, gypsum, and iron-bearing materials.

Clays.—Output included fire, ball, and common clays. Fire clay was mined by 4 companies at 12 operations, while 2 companies mined ball clay at 4 operations. Common clay and shale production was reported by 8 companies at 10 operations. Ball and fire clays were processed and packaged, or shipped in bulk to manufacturers of pottery ware, floor and wall tile, or used as paper filler, in refractory ware, and firebrick. Major end products of common clay were common and face brick, quarry tile, concrete block, and portland cement.

Fluorspar.—In the latter part of 1978, the Frontier Spar Corp. closed its Babb-Barnes underground mine and mill near Salem. During 1979, exploration continued on other properties, but no fluorspar or byproduct zinc was produced.

Lime.—Production of lime was reported by two companies during 1978 and 1979. Quicklime, produced by the Black River Mining Co. from an underground mine in Pendleton County, was used primarily by the steel industry. The Dravo Lime Co. plant, on the Ohio River near Maysville, produced thiosorbic lime used in sulfur dioxide removal from electric-generating plant stack gases.

Mullite.—NL Industries, Inc., produced high-temperature sintered synthetic mullite at its Greenup County plant, primarily for use in refractory products.

Perlite.—Grefco, Inc., in Boone County, and W. R. Grace & Co., in Campbell County, processed ores shipped from out of State; they produced expanded perlite used primarily for roof insulation and agricultural needs.

Sand and Gravel.—Output of sand and gravel increased nearly 35% in 1978 because of a rise in construction activity. This was followed by a 12% decline in 1979. During both years, output of sand and gravel constituted 12% of the State's nonfuel mineral value.

In 1979, sand and gravel was produced at 37 operations in 23 counties. Leading counties, in descending order of output, were Livingston, Boone, Breckinridge, Jefferson, and Daviess. Construction sand and gravel comprised most of the commodity produced and was used primarily for concrete aggregate, fill, and concrete products. A small amount of industrial sand was also produced for use in mold and core and sandblasting. Modes of transportation included truck and barge.

Table 4.—Kentucky: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	4,828	$10,123	$2.10	6,014	$12,066	$2.01	6,506	$13,449	$2.07
Plaster and gunite sands	NA	NA	NA	W	W	W	811	1,643	2.02
Concrete products	908	2,362	2.60	983	1,474	1.50	669	1,533	2.29
Asphaltic concrete	1,756	3,497	1.99	2,280	4,641	2.04	1,339	3,133	2.34
Roadbase and coverings	446	741	1.66	571	1,037	1.82	320	832	2.60
Fill	1,715	2,209	1.29	3,062	4,038	1.32	1,932	2,712	1.40
Snow and ice control	NA	NA	NA	71	96	1.35	46	117	2.52
Railroad ballast	W	W	W	9	17	1.96	9	18	1.99
Other uses	50	159	3.18	186	532	2.86	93	284	3.05
Total[1] or average	9,704	19,091	1.97	13,180	23,900	1.81	11,726	23,721	2.02

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Data may not add to totals shown because of independent rounding.

Table 5.—Kentucky: Sand and gravel sold or used by producers, by use

Use	1977 Quantity (thousand short tons)	1977 Value (thousands)	1977 Value per ton	1978 Quantity (thousand short tons)	1978 Value (thousands)	1978 Value per ton	1979 Quantity (thousand short tons)	1979 Value (thousands)	1979 Value per ton
Construction:									
Sand	7,622	$14,556	$1.91	9,571	$16,040	$1.68	9,378	$18,210	$1.94
Gravel	2,082	4,535	2.18	3,606	7,860	2.18	2,349	5,512	2.35
Total[1] or average	9,704	19,091	1.97	13,180	23,900	1.81	11,726	23,721	2.02
Industrial sand	61	595	9.78	W	W	W	W	W	W
Grand total[1] or average	9,764	19,686	2.02	W	W	W	W	W	W

W Withheld to avoid disclosing company proprietary data.

[1] Data may not add to totals shown because of independent rounding.

Stone.—Kentucky's most important nonfuel mineral resource is stone. Crushed stone was produced by 51 companies at 99 mines and quarries in 65 counties. In 1978, production increased nearly 13% over 1977 levels, and remained essentially the same in 1979. Main uses of the stone were for roadstone, roadbase aggregate, concrete aggregate, and riprap. Although trucking is the major mode of transportation, rail and water transportation is available for large bulk tonnage shipments.

Vermiculite.—Crude vermiculite mined in other States was exfoliated by W. R. Grace & Co. at its plant in Campbell County. The product was used primarily in loose-fill and block insulation, fireproofing, lightweight aggregate, and soil conditioning.

Table 6.—Kentucky: Crushed limestone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977 Quantity	1977 Value	1978 Quantity	1978 Value	1979 Quantity	1979 Value
Agricultural limestone	2,295	5,650	2,133	6,105	1,675	5,346
Poultry grit and mineral food	W	W	6	72	6	72
Concrete aggregate (coarse)	[r]3,457	[r]9,074	3,767	10,355	4,076	13,032
Bituminous aggregate	4,418	11,627	3,835	11,035	4,097	13,184
Macadam aggregate	1,258	2,735	1,456	3,636	1,465	3,952
Dense-graded roadbase stone	8,226	20,377	9,316	25,060	9,352	27,547
Surface treatment aggregate	1,388	3,382	2,833	7,239	1,122	3,360
Other construction aggregate and roadstone	7,942	18,956	10,770	28,062	10,578	30,187
Riprap and jetty stone	3,961	9,494	3,086	7,532	2,744	7,297
Railroad ballast	121	308	111	297	280	750
Filter stone	82	230	132	388	216	694
Manufactured fine aggregate (stone sand)	118	313	438	1,152	797	2,424
Cement manufacture	1,045	1,796	907	1,510	W	W
Lime manufacture	1,242	2,505	1,365	2,790	W	W
Flux stone	72	213	70	210	66	218
Mine dusting	W	W	266	1,683	281	2,022
Asphalt filler	--	--	1	5	(2)	3
Other uses[3]	444	2,123	253	636	2,543	6,562
Total[4]	36,068	88,782	40,743	107,769	39,298	116,641

[r] Revised. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] 1977-78 data includes sandstone and limestone.

[2] Less than 1/2 unit.

[3] Includes stone used for agricultural marl and other soil conditioners (1978), whiting (1978), other fillers (1978-79), acid neutralization, fill, unspecified uses, and uses indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

METALS

Aluminum.—The National-Southwire Aluminum Co. continued operations at Hawesville in Hancock County. Anaconda Aluminum Co., at Sebree, completed an $80 million expansion project in 1979 that increased plant output to nearly 180,000 tons of aluminum per year.

Iron and Steel.—Armco Steel Corp. produced small quantities of both pig iron and iron oxide pigments at its Ashland plant in Boyd County. Interlake, Inc., continued to produce flat-rolled steel sheets and coils at its Newport plant.

Lead and Zinc.—The Frontier Spar Corp. produced small quantities of lead and zinc as byproducts of fluorspar processing at its Babb-Barnes mine in Crittenden County. During 1978, a total of 113,400 pounds of zinc was recovered, having a total value of $35,154. The company shut down its operations in the fourth quarter of 1978. No production was reported in 1979.

In 1979, Cominco American Corp., a joint venture with ASARCO Inc. and NL Industries, Inc., completed a 2,210-foot shaft at the Prewitt Hollow zinc prospect in Cumberland County. Test drilling was underway to outline the ore body.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum (primary):			
Anaconda Aluminum Co	Box 1654 Louisville, KY 40201	Smelter	Henderson.
National-Southwire Aluminum Co.	Box M Hawesville, KY 42348	do	Hancock.
Cement:			
The Flintkote Cement Co.[1]	Dixie Highway Kosmosdale, KY 40272	Plant	Jefferson.
Clays:			
Kentucky Solite Corp	Box 27211 Richmond, VA 23261	Mine and plant	Bullitt.
Kentucky-Tennessee Clay Co	Box 77 Mayfield, KY 42066	do	Graves.
Old Hickory Clay Co	Box 271 Paducah, KY 42351	do	Do.
Ferroalloys:			
Airco, Inc	Box 217 Calvert City, KY 42029	Plant	Marshall.
Iron (pig):			
Armco Steel Corp	Middletown, OH 45202	do	Boyd.
Interlake, Inc	9th & Lowell Sts. Newport, KY 41071	do	Campbell.
Lime:			
Black River Mining Co	Route 1 Butler, KY 41006	Mine and plant	Pendleton.
Dravo Lime Co	650 Smithfield St. Pittsburgh, PA 15222	do	Mason.
Perlite (expanded):			
W. R. Grace & Co.[2]	62 Whittemore Ave. Cambridge, MA 02140	Plant	Campbell.
Grefco, Inc	Box 35 Florence, KY 41042	do	Kenton.
Sand and gravel:			
Evansville Materials, Inc	624 NW. Riverside Dr. Evansville, IN 47708	Dredge	Henderson.
Ingram Materials, Inc	Box 1049 Nashville, TN 37202	do	Livingston.
Martin Marietta Corp.[3]	Box 789 Cedar Rapids, IA 52406	Dredge and pits	Boone, Carroll, Jefferson, Oldham.
Nugent Sand Co	Box 6072 Louisville, KY 40206	Dredge	Jefferson.
E. T. Slider, Inc	Box 6041 Louisville, KY 40206	do	Do.
Stone:			
Kentucky Stone Co	400 Sherburn Lane Louisville, KY 40207	Underground mines, quarries, plants.	Various.
Medusa Aggregates Co	175 Moore Dr. Lexington, KY 40502	do	Fayette.
Reed Crushed Stone Co	Box 35 Gilbertsville, KY 42044	Quarry and plant	Livingston.
Three Rivers Rock Co	Box 218 Smithland, KY 42081	do	Do.

[1] Also clays.
[2] Also exfoliated vermiculite.
[3] Also stone.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

[2] Assistant state geologist, Kentucky Geological Survey, University of Kentucky, Lexington, Ky.

[illegible]

The Mineral Industry of Louisiana

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Louisiana Geological Survey, for collecting information on all nonfuel minerals.

By Murphy E. Hawkins[1] and Charles G. Groat[2]

The Louisiana nonfuel mineral industry continued to make an important contribution to the State's economy, producing $356 million in 1978 and $455 million in 1979. Salt and sulfur were the most significant raw minerals produced in terms of value. During the 1970's, Louisiana consistently was ranked either first or second among the States in output of these two important industrial minerals. Important to the State and regional economies was the production of notable quantitites of cement, clays, gypsum, lime, sand and gravel, and stone.

Table 1.—Nonfuel mineral production in Louisiana[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	401	$785	517	$4,786	416	$6,073
Salt do	13,201	96,878	14,263	110,472	14,207	113,167
Sand and gravel do	21,987	50,790	22,010	56,080	[2]20,446	[2]54,081
Stone (crushed) do	9,710	26,920	9,130	26,921	W	W
Sulfur (Frasch) thousand metric tons	2,494	W	1,984	W	2,858	W
Combined value of cement, gypsum, lime, sand and gravel (industrial, 1979), and values indicated by symbol W	XX	174,912	XX	157,996	XX	281,955
Total	XX	350,285	XX	356,255	XX	455,276

W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Louisiana, by parish[1]

(Thousands)

Parish	1977	1978	Minerals produced in 1978 in order of value
Allen	W	W	Sand and gravel.
Ascension	W	W	Salt.
Assumption	W	W	Do.
Beauregard	W	$2,684	Sand and gravel.
Bienville	W	W	Clays.
Caddo	W	W	Do.
Calcasieu	W	W	Salt.
Cameron	W	--	
Catahoula	$738	470	Sand and gravel.
East Baton Rouge	W	W	Sand and gravel, clays.
East Carroll	38	38	Sand and gravel.
East Feliciana	3,057	2,928	Do.
Grant	3,125	3,757	Do.
Iberia	W	56,237	Salt.
Iberville	W	W	Do.
Jefferson	W	W	Sulfur, salt.
Jefferson Davis	W	W	Sand and gravel.
Lafayette	460	418	Do.
Lafourche	W	W	Sulfur.
La Salle	980	W	Sand and gravel.
Lincoln	W	6	Clays.
Livingston	1,027	836	Sand and gravel.
Madison	W	W	Do.
Morehouse	W	W	Do.
Natchitoches	W	W	Clays, sand and gravel.
Orleans	W	W	Cement, stone, lime.
Ouachita	2,348	3,179	Sand and gravel.
Plaquemines	W	W	Sulfur, salt.
Pointe Coupee	W	W	Clays.
Rapides	3,992	4,969	Sand and gravel.
Red River	W	658	Do.
Sabine	W	W	Stone, sand and gravel.
St. Bernard	W	W	Sand and gravel, clays.
St. Helena	W	W	Do.
St. James	--	W	Salt.
St. Martin	W	W	Salt, sand and gravel, clays.
St. Mary	W	W	Salt, lime, stone.
St. Tammany	W	W	Sand and gravel, stone, clays.
Tangipahoa	2,711	3,158	Sand and gravel.
Union	276	276	Sand and gravel.
Vermilion	413	--	
Vernon	766	845	Sand and gravel.
Washington	3,985	4,797	Do.
Webster	5,398	6,750	Do.
West Feliciana	2,038	673	Do.
Winn	W	W	Stone, gypsum, sand and gravel.
Undistributed[2]	318,936	263,582	
Total[3]	350,285	356,255	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] No nonfuel mineral production was reported for Acadia, Avoyelles, Bossier, Caldwell, Claiborne, Concordia, De Soto, Evangeline, Franklin, Jackson, Richland, St. John the Baptist, St. Landry, Tensas, Terrebonne, West Baton Rouge, and West Carroll Parishes.

[2] Includes values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Louisiana business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force .... thousands..	1,570.0	1,623.0	1,679.0	+3.5
Unemployment .... do....	109.0	113.0	112.0	-.9
Employment (nonagricultural):				
Mining .... do....	68.0	73.7	74.8	+1.5
Manufacturing .... do....	203.3	209.5	213.3	+1.8
Contract construction .... do....	111.1	124.4	124.8	+.3
Transportation and public utilities .... do....	103.6	113.3	115.0	+1.5
Wholesale and retail trade .... do....	324.6	345.4	354.9	+2.8
Finance, insurance, real estate .... do....	66.1	70.7	73.5	+4.0
Services .... do....	230.5	246.2	250.7	+1.8
Government .... do....	257.4	280.3	290.6	+3.7
Total nonagricultural employment .... do....	1,364.6	1,463.5	1,497.6	+2.3
Personal income:				
Total .... millions..	$23,487	$26,723	$30,042	+12.4
Per capita	$5,977	$6,738	$7,477	+11.0
Construction activity:				
Number of private and public residential units authorized	26,365	[2]27,087	22,418	-17.2
Value of nonresidential construction .... millions..	$412.8	$544.2	595.8	+9.5
Value of State road contract awards .... do....	$280.9	$294.0	$275.0	-6.5
Shipments of portland and masonry cement to and within the State .... thousand short tons..	2,617	2,956	2,846	-3.7
Nonfuel mineral production value:				
Total crude mineral value .... millions..	$350.3	$356.3	$455.3	+27.8
Value per capita, resident population	$89	$90	$113	+25.6
Value per square mile	$7,219	$7,342	$9,383	+27.8

[p] Preliminary.

[1] Includes oil and gas extraction.

[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

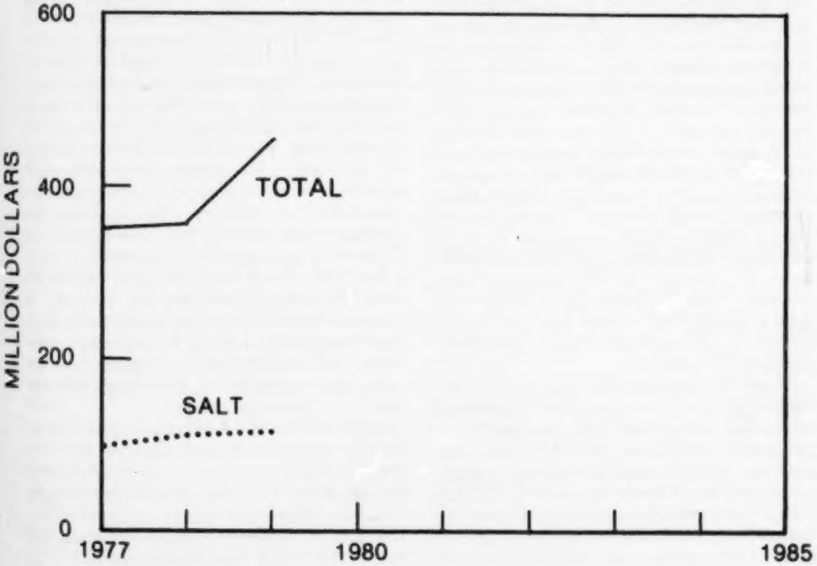

Figure 1.—Value of salt and total value of nonfuel mineral production in Louisiana.

Trends and Developments.—Louisiana industry is almost entirely energy intensive, attracted to the State in years past by the abundance of low-cost mineral fuels. Recently, however, the increasing cost of fuels, supply uncertainties, and national fuel usage priorities have forced a reassessment. To meet future electricity needs, the State's utilities are making long-term commitments to coal. With the exception of lignite, the State has no coal reserves and is faced with the problem of planning for transportation and distribution of large quantities of coal.

LOOP, Inc. (an acronym for Louisiana Offshore Oil Port), was the first organization in the United States to accept a Federal license, issued by the Department of Transportation in 1977, for building a deepwater port. The port was expected to be operational in 1980. The terminal will be located approximately 19 miles offshore in Lafourche Parish. The entire LOOP system will include 19 miles of offshore pipelines and 28 miles of pipeline through the onshore marshland to Clovelly salt dome underground storage cavities. A separately owned pipeline will transport oil from storage to the St. James terminus of a crude oil pipeline serving the Midwest and connecting or interconnecting with approximately 25% of the Nation's refining capacity.

The first phase of LOOP's operation will furnish a capacity of 1.4 million barrels of crude per day. A study by H. J. Kaiser Co., contracted by the Louisiana Offshore Terminal Authority, projected that employment gains in southeast Louisiana due to the LOOP operation (both from direct employment and from ancillary industry employment) would amount to 16,250 in 1980 and to 46,850 in 2010. An Arthur D. Little Company study projected that increased wage income due to refining and petrochemical-related activities plus ancillary industry development would amount to $168 million in 1980 and to $3.6 billion in 2010 (in terms of 1975 dollars).

Increased exploration due to higher prices resulted in an increased number of producing gas wells in 1977, and the 3-year production decline was halted, at least temporarily. Deep Cretaceous drilling, prompted by the False River gas find in 1975, is called by exploration geologists probably the most significant development along the gulf coast in recent years. Drilling is completed, underway, or planned along a belt stretching some 200 miles from Allen Parish northeast of Lake Charles to St. Bernard Parish southeast of New Orleans.

Louisiana's 10-year tax exemption law provides that any manufacturer building a new facility in Louisiana or expanding an established Louisiana facility is eligible to receive exemptions on ad valorem taxes on buildings and equipment at State, parish, and local levels for a period of 5 calendar years, renewable for an additional 5 years.

In 1977 the Louisiana Department of Commerce and Industry approved 10-year ad valorem tax exemptions for industrial developments totaling $2.3 billion. This amount represented 52 new plants ($1 billion) and 392 expansions of existing plants ($1.3 billion). The year 1977 was the first that investment in new plants alone surpassed $1 billion. Investment in mineral-related industrial categories accounted for 58% of the total investment. Six parishes had industrial investments totaling more than $100 million each. These were St. Charles — $624 million; Pointe Coupee — $592 million; West Baton Rouge — $215 million; Ouachita — $149 million; Iberville — $128 million; and East Baton Rouge — $109 million.

Legislation and Government Programs.—In 1978, a set of policies for Louisiana's mineral-lease sales, aimed at stabilizing the State's mineral development, was established by the Department of Natural Resources. The policies state that the Natural Resources Secretary shall evaluate each mineral-leasing proposal for State-owned property and that standards shall be drawn up to provide the mineral industry with some degree of security in its operations by informing the industry when requests for leasing of minerals will be met and under what conditions leases will be granted.

In 1978, Governor Edwards issued an executive order forbidding the issuance of any new permits for dumping hazardous waste until the Natural Resources Department could promulgate new guidelines for the safe transportation, handling, and disposition of toxic materials.

In July 1978, the Legislature passed Senate Bill 930 (which later became Act 361) establishing a State and local Coastal Zone Management (CZM) program. The Senate voted to concur with major revisions which the House Natural Resources Committee had made. These revisions were designed in part to remedy deficiencies which the Federal Office of Coastal Zone Management had cited. The Federal Government had required changes in the version of the bill as passed by the State Senate to insure that adequate procedures for implementing the objectives of the Federal Coastal Zone Management Act were included. These management procedures will affect lime-, salt-, and sulfur-producing areas.

The National Oceanic and Atmospheric Administration granted Louisiana $700,000 as part of its CZM program funding in 1978. The State must add $175,000 in matching funds. Seventeen coastal parishes will share $385,000 of this total to draw up their own plans for managing environmentally valuable marshlands. In an attempt to balance the need for preserving the environment with the need for developing the coastal areas, the State will use $130,000 to comply with Federal provisions of the CZM bill. Another portion of the money will be devoted to special CZM projects in five parishes.

Over the past decade, foreign investments have accounted for about 10% of the State's industrial growth. Recognizing the economic importance of these investments, Louisiana is vigorously seeking to attract new investors from abroad. During the biennium, the State opened new trade and investment offices in Paris, France, and Frankfurt, Federal Republic of Germany. Some 40 international firms have invested an estimated $2.2 billion in Louisiana manufacturing facilities. Another 60 firms have invested $1.8 billion in nonmanufacturing ventures including salt mines, grain elevators, distribution centers, and oil- and gas-related projects.

During the period, Louisiana State University was designated by the Secretary of the Interior as a State Mining and Mineral Resources and Research Institute pursuant to Title III of Public Law 95-87.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Barite.—Imported from Arkansas, Missouri, and Latin American countries, crude barite was ground in seven Louisiana plants for use as a weighting agent in oil well drilling fluids. Three of the plants are in New Orleans, two are near Morgan City, and there is one each in Lake Charles and Houma. In late 1979, IMC Services (Division of Halliburton Co.) was constructing a new barite grinding plant near Houma. Crude barite for processing in this plant will be imported from Missouri, Nevada, and foreign sources.

Cement.—During 1978-79, Lone Star Industries, Inc., and Louisiana Cement Co. (Division of OKC Corp.) each operated a wet-process cement plant in New Orleans. Both companies produced portland cement. The Louisiana Cement Co. also prepared masonry cement. Over 95% of the total cement production in Louisiana was portland.

Oystershell, dredged from shallow bays and near-gulf lakes, and limestone shipped from Alabama continued to be the principal raw materials used in preparing cement.

Demand for cement continued high during most of 1978 and throughout 1979. Cement supply was tight in local areas because of transportation shortages, plant-operating problems, and in some instances, lack of productive capacity. Cement and clinker imported from foreign sources helped alleviate the shortage. Imports, principally from Mexico, Spain, and the United Kingdom, totaled over 350,000 tons in 1978 and almost 550,000 tons in 1979.

Clays.—One lightweight aggregate, one cement, and six brick companies mined clay in 1978-79. Most of the clay output was used in producing lightweight aggregate and cement. The amount of clay used in Louisiana brick production has declined in recent years because sharply rising energy and other production costs have resulted in closing or reducing some brick-plant operations.

Table 4.—Louisiana: Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1975	531	1,132
1976	513	1,158
1977	401	785
1978	517	4,786
1979	416	6,073

Gypsum.—Winn Rock, Inc., near Winnfield in Winn Parish, continued to quarry gypsum. Crude gypsum is used mostly as cement retarder, and demand was strong during 1978-79 because construction activities kept cement sales at high levels.

The National Gypsum Co. and the United States Gypsum Co. calcined imported gypsum to produce wallboard and other products at plants in Jefferson and Orleans Parishes.

Lime.—The United States Gypsum Co. and the Pelican State Lime Division of Southern Industries Corp. prepared lime at plants in New Orleans and Morgan City, respectively. Oystershell continued to be the principal raw material used to manufacture lime at these plants. Most of the product was used at chemical and industrial plants and for refractories.

Perlite (Expanded).—W. R. Grace & Co. (Orleans Parish), American Perlite Products (Caddo Parish), and Filter Media Co. of Louisiana (St. John Parish) imported and processed crude perlite. The expanded product was used principally as a filter aid, for low-temperature insulation, as a soil conditioner, and elsewhere in horticulture.

Salt.—In 1979, 14 companies operated 16 salt-mining operations in 10 southern Louisiana parishes. Five of the mines were underground; the remainder were solution mines. Most of the salt output was produced and consumed as brine in the State's extensive chemical industry.

Louisiana retained its top ranking among the States in total production of salt, although a number of factors affected rock-salt and brine availability during 1978-79. For example, in 1978, the U.S. Department of Energy (DOE) purchased the Weeks Island underground mine from Morton Salt Co. for $30 million for use as a strategic crude oil storage site. Although Morton continued to mine salt during the conversion, output was reduced. In July 1978, the company began sinking two shafts in another part of the salt dome; by yearend 1979, the shafts were connected by a decline drift and the construction of ore pockets and other underground development work was well underway. The new Weeks Island Mine is to be in production by mid-1980.

An explosion in Cargill's Belle Isle mine on June 8, 1979, killed several miners and severely damaged hoisting and other underground facilities. Production was scheduled to resume in January 1980. Federal mine inspectors concluded that the Belle Isle explosion was caused by methane gas. Tests indicated that the gas entrapped within the rock salt is released into the mine in copious quantities in some instances, such as during blasting. Subsequent methane tests conducted by Federal inspectors in the four other underground mines resulted in assigning a gassy classification to Cote Blanche Island, Jefferson Island, and Weeks Island, in addition to Belle Isle. The gassy-mine classification adds significantly to operating cost because of the additional precautions and equipment required.

In 1978, DOE completed converting the Bayou Choctaw solution mine in Iberville Parish to a crude oil storage site. Although the Cote Blanche Island underground mine was one of four salt-mining operations determined to be environmentally acceptable for oil storage, by yearend 1979 the Federal Government had not filed an expropriation suit to take possession.

Sand and Gravel.—Building activities in Louisiana remained at fairly high levels, sustaining a good market for sand and gravel producers who supply this material to the highway and general construction industries. With more than 150 workable pits, sand and gravel operations represented the most widespread mining activity in the State, although a significant number of the pits were operated intermittently. Sev-

Table 5.—Louisiana: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	11,277	$29,376	$2.60	11,499	$29,917	$2.60	11,023	$31,072	$2.82
Plaster and gunite sands	NA	NA	NA	--	--	--	--	--	--
Concrete products	1,575	3,485	2.21	1,738	4,088	2.35	1,515	3,692	2.44
Asphaltic concrete	2,737	6,876	2.51	3,032	9,173	3.03	3,200	10,172	3.18
Roadbase and coverings	2,874	5,298	1.84	3,511	7,285	2.08	2,866	6,580	2.30
Fill	3,186	3,481	1.09	1,840	2,299	1.25	1,716	2,204	1.28
Snow and ice control	NA	NA	NA	--	--	--	--	--	--
Other uses	54	119	2.20	115	286	2.49	127	362	2.85
Total[1] or average	21,703	48,635	2.24	21,740	53,050	2.44	20,446	54,081	2.65

NA Not available.

[1] Data may not add to totals shown because of independent rounding.

Table 6.—Louisiana: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	10,227	$19,125	$1.87	9,284	$18,831	$2.03	8,593	$18,173	$2.11
Gravel	11,476	29,510	2.57	12,451	34,218	2.75	11,853	35,907	3.03
Total[1] or average	21,703	48,635	2.24	21,740	53,050	2.44	20,446	54,081	2.65
Industrial sand	284	2,155	7.58	273	3,032	11.11	W	W	W
Grand total[1] or average	21,987	50,790	2.31	22,010	56,080	2.55	W	W	W

W Withheld to avoid disclosing company proprietary data.
[1] Data may not add to totals shown because of independent rounding.

eral new sand and gravel operations were opened in 1978-79, particularly in parishes that serve the urban growth markets of Baton Rouge, New Orleans, and Shreveport.

Although sand and gravel was mined in over one-half of the State's parishes, East Baton Rouge, Rapides, St. Helena, St. Tammany, Washington, and Webster Parishes contibuted more than half the State's total production.

Stone.—Virtually all production was shell (oyster and clam) dredged from shallow bays and near-gulf lakes. Nine companies operated shell dredges in 1978-79. One company quarried anhydrite from the caprock overlying a near-surface salt dome in Winn Parish. The stone production was used for animal- feed supplement, concrete aggregate, paint filler, raw material, and rubber filler, and in preparing lime and cement.

Table 7.—Louisiana: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Bituminous aggregate	139	444	W	W	W	W
Dense-graded roadbase stone	3,471	[r]13,007	2,497	9,364	2,410	8,533
Other construction aggregate and roadstone	4,233	10,034	4,498	12,499	4840	16,140
Other uses[2]	1,867	3,434	2,135	5,058	1,407	4,077
Total[3]	9,710	26,920	9,130	26,921	W	W

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."
[1] Includes sandstone, shell, and miscellaneous stone.
[2] Includes stone used for poultry grit and mineral food, riprap and jetty stone, cement manufacture, lime manufacture, other miscellaneous uses, and uses indicated by symbol W.
[3] Data may not add to totals shown because of independent rounding.

Sulfur.—In early 1978, Freeport Sulphur Co. closed the 44-year-old Grand Ecaille sulfur mine in Plaquemines Parish; and in July 1978, Texasgulf, Inc., closed the Bully Camp mine in LaFourche Parish, the company's only Louisiana operation. Declining sulfur reserves and sharply rising operating costs were cited as reasons for the closures. Only two Frasch sulfur mines were operated in Louisiana during 1979. Freeport recovered sulfur at the Garden Island Bay mine near the mouth of the Mississippi River in Plaquemines Parish and at the Grand Isle mine, in about 50 feet of water approximately 7 miles offshore from Jefferson Parish.

Shipments of Louisiana Fresch sulfur exceeded production in 1979; inventories were reduced by over 100,000 metric tons. Price also improved during the year. At yearend 1979, Freeport announced an increase to $106 per ton in domestic liquid-sulfur prices at the company's Tampa, Fla., terminals; equivalent increases were posted at other locations. Freeport officials also reported that spot export quotation had exceeded $130 per ton f.o.b. Port Sulphur, La., in 1979.

Freeport began developing its Caillou Island sulfur deposit in late 1979, to go onstream in early 1981. Located in the marshy coastal area of southern Terrebonne Parish, the new mine will use the barge-mounted powerplant from the Lake Pelto Frasch operation closed in 1975.

Table 8.—Louisiana: Sulfur produced and shipped from Frasch mines

(Thousand metric tons and thousand dollars)

Year	Production	Shipments	
		Quantity	Value
1975	3,119	2,715	W
1976	2,527	2,484	W
1977	2,461	2,494	W
1978	1,928	1,984	W
1979	2,460	2,858	W

W Withheld to avoid disclosing company proprietary data.

Vermiculite.—Crude vermiculite mined outside of Louisiana was exfoliated by W. R. Grace & Co. in Orleans Parish. The product was used for plaster and concrete aggregate, or loose and block-fill insulation, in horticulture, and as a soil conditioner.

METALS

Aluminum.—Bauxite from Jamaica and Surinam was processed into alumina at Ormet Corp.'s Burnside refinery and at Kaiser Aluminum and Chemical Corp.'s Baton Rouge and Gramercy refineries in 1978-79.

In late 1979, Kaiser announced that it will spend several million dollars to increase energy efficiency at its Baton Rouge alumina plant. To be completed in three stages by 1982, the project will not affect the plant's productive capacity but will significantly reduce energy consumption.

Primary aluminum metal was smelted at the Kaiser works at Chalmette and at Consolidated Aluminum Corp.'s works near Lake Charles.

Nickel.—AMAX Nickel Refining Co., Inc., a division of AMAX, Inc., continued to treat imported intermediate (matte) materials at the Port Nickel facility about 15 miles downriver from New Orleans. During 1978, nickel-copper-cobalt matte from Botswana and the Republic of South Africa and nickel-cobalt matte from New Caledonia were the principal feedstocks for this refinery. In early 1979, the plant received the first shipment of matte from Australia under a 10-year contract that assures the refinery of supply stability over the near term.

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[1] State mineral specialist, Bureau of Mines, Denver, Colo.

[2] State geologist, Louisiana Geological Survey, Baton Rouge, La.

Table 9.—Louisiana: Principal producers

Commodity and company	Address	Type of activity	Parish
Aluminum:			
Consolidated Aluminum Corp	Box LL Lake Charles, LA 70601	Plant	Calcasieu.
Kaiser Aluminum & Chemical Corp	Box 1600 Chalmette, LA 70043	do	St. Bernard.
Cement:			
Lone Star Industries, Inc	1 Greenwich Plaza Greenwich, CT 06830	do	Orleans.
OKC Corp	Box 10426 Dallas, TX 75207	do	Do.
Clays:			
Big River Industries, Inc	Box 66377 Baton Rouge, LA 70806	Mine and plant	Pointe Coupee.
Kentwood Brick & Tile Manufacturing Co., Inc.	Drawer F Kenwood, LA 70444	do	St. Helena.
Gypsum:			
Winn Rock, Inc	Box 790 Winnfield, LA 71483	Quarry and plant	Winn.
Lime:			
Southern Industries Corp	Box 26223 Birmingham, AL 35226	Plant	St. Mary.
U.S. Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Orleans.
Salt:			
Cargill, Inc	Cargill Bldg. Minneapolis, MN 55402	Underground mine	St. Mary.
Diamond Crystal Salt Co	916 Riverside Ave. St. Clair, MI 48079	do	Iberia.
Domtar Chemicals, Inc., Shifto Salt Div	9950 West Lawrence Suite 400 Shiller Park, IL 60276	do	St. Mary.
The Dow Chemical Co	Midland, MI 48640	Brine wells	Iberville.
International Salt Co	Clarks Summit, PA 18411	Underground mine	Iberia.
Morton Salt Co	110 North Wacker Dr. Chicago, IL 60606	do	Do.
PPG Industries, Inc	Box 1000 Lake Charles, LA 70604	do	Calcasieu.
Sand and gravel:			
Gifford-Hill & Co., Inc	Box 47127 Dallas, TX 75247	Plant and dredge	Jefferson Davis, Tangipahoa, Webster.
Louisiana Sand and Gravel Co	Box 963 Baton Rouge, LA 70800	do	East Baton Rouge.
Standard Gravel Co., Inc	Route 4, Box 17 Franklinton, LA 70438	do	Washington.
Shell:			
Lake Charles Dredging & Towing Co	Lafayette, LA 70501	Dredge	St. Mary.
Louisiana Materials Co	Box 8214 New Orleans, LA 70122	do	St. Tammany.
Southern Industries, Inc	Drawer 946 Mobile, AL 36601	do	Orleans.
Stone:			
Winn Rock, Inc	Box 790 Winnfield, LA 71483	Quarry and plant	Winn.
Sulfur, native:			
Freeport Minerals Co	161 East 42d St. New York, NY 10017	Frasch process	Jefferson and Plaquemines.
Texasgulf, Inc	200 Park Ave. New York, NY 10017	do	Lafourche.
Sulfur, recovered:			
Cities Service Oil Co	Box 300 Tulsa, OK 74102	Refinery	Calcasieu.
Exxon Co., U.S.A	Box 551 Baton Rouge, LA 70821	Plant	East Baton Rouge.
Vermiculite, exfoliated:			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	do	Orleans.

The Mineral Industry of Maine

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Maine Geological Survey, for collecting information on all nonfuel minerals.

By Doss H. White, Jr.[1] and Walter Anderson[2]

The value of Maine's nonfuel mineral production in 1978 and 1979 was $42.8 million and $45.9 million, respectively. Sand and gravel was the leading mineral commodity produced in terms of value, followed by cement and crushed stone. Other commodities mined or processed included clay, garnet, gem stones, synthetic graphite, peat, and expanded perlite.

During the 1970's, the value of mineral production increased approximately 50%, with an annual increase recorded for 8 of the 10 years. The value of mineral production fell in 1971, a result of the 1970 recession, and value again decreased in 1978, reflecting the closing of the State's last metal mine the previous year.

Table 1.—Nonfuel mineral production in Maine[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays .... thousand short tons	98	$160	100	$164	90	$163
Copper (recoverable content of ores, etc.) short tons	1,337	1,787	--	--	--	--
Gem stones	NA	W	NA	W	NA	W
Lead .... short tons	178	109	--	--	--	--
Peat .... thousand short tons	5	80	4	153	3	202
Sand and gravel .... do	10,487	19,023	11,530	22,470	11,022	20,534
Stone (crushed) .... do	1,312	4,110	1,655	5,510	2,069	7,492
Zinc (recoverable content of ores, etc.) short tons	7,269	5,001	--	--	--	--
Combined value of other nonmetals and values indicated by symbol W	XX	12,955	XX	14,485	XX	17,519
Total	XX	43,225	XX	42,782	XX	45,910

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Maine, by county

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Androscoggin	W	W	Sand and gravel, clays.
Aroostook	W	W	Sand and gravel, stone.
Cumberland	W	W	Sand and gravel, stone, clays.
Franklin	$536	$918	Sand and gravel.
Hancock	W	1,070	Sand and gravel, clays.
Kennebec	W	W	Sand and gravel, stone.
Knox	W	W	Cement, stone, sand and gravel, clays.
Lincoln	430	510	Sand and gravel.
Oxford	W	W	Sand and gravel, feldspar.
Penobscot	3,034	3,595	Sand and gravel.
Piscataquis	648	334	Do.
Sagadahoc	W	W	Do.
Somerset	599	891	Do.
Waldo	W	W	Sand and gravel, peat.
Washington	W	W	Sand and gravel, peat, stone.
York	1,762	2,526	Sand and gravel.
Undistributed[1]	36,215	32,934	
Total[2]	43,225	42,782	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes gem stones and values indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Maine business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	470.0	473.0	489.0	+3.4
Unemployment do.	39.0	29.0	35.0	+20.7
Employment (nonagricultural):				
Mining do.	(1)	(1)	(1)	--
Manufacturing do.	105.9	111.3	114.0	+2.4
Contract construction do.	19.8	19.4	18.9	-2.6
Transportation and public utilities do.	18.0	18.0	18.8	+4.4
Wholesale and retail trade do.	83.6	88.3	90.5	+2.5
Finance, insurance, real estate do.	15.3	15.7	16.3	+3.8
Services do.	[2]67.5	[2]71.4	[2]75.2	+5.3
Government do.	77.7	81.5	82.6	+1.3
Total nonagricultural employment do.	387.8	405.6	116.3	+2.6
Personal income:				
Total millions	$6,210	$6,884	$7,741	+12.5
Per capita	$5,727	$6,308	$7,057	+11.9
Construction activity:				
Number of private and public residential units authorized	4,753	[3]5,614	3,966	-29.4
Value of nonresidential construction millions	$59.5	$69.6	$80.8	+16.1
Value of State road contract awards do.	$30.5	$50.0	$46.0	-8.0
Shipments of portland and masonry cement to and within the State thousand short tons	269	272	254	-6.6
Nonfuel mineral production value:				
Total crude mineral value millions	$43.2	$42.8	$45.9	+7.2
Value per capita, resident population	$40	$39	$42	+7.7
Value per square mile	$1,301	$1,286	$1,382	+7.5

[p] Preliminary.

[1] Included with "Services."

[2] Includes mining.

[3] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

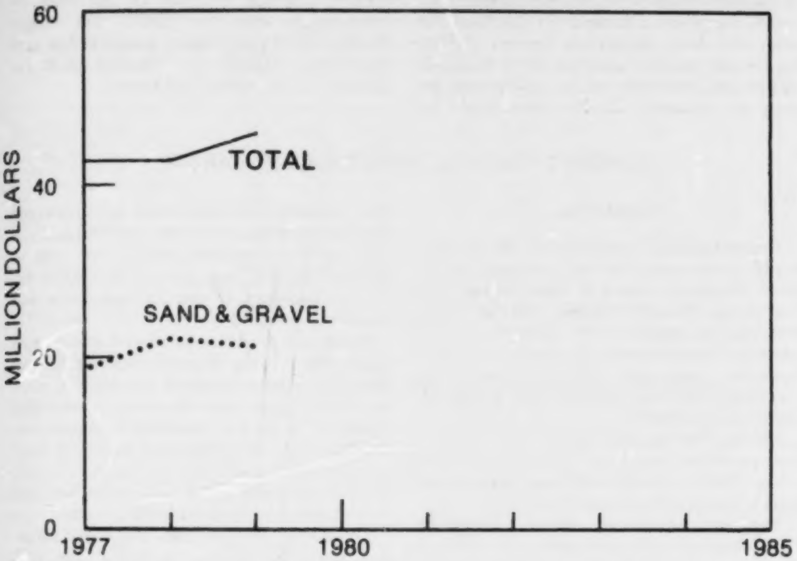

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Maine.

Exploration for metallic ore deposits continued, stimulated by the discovery of a major copper-zinc ore body at Bald Mountain in Aroostook County on the Canadian border. A number of major companies were active in exploration at locations extending from Parmachenee Lake in the west to Fish River Lake in north-central Maine.

Legislation and Government Programs.—The 1979 legislature amended the State's water standards to allow potable waste water discharge into Class A waters. This change was necessary for the continued development of the $1 billion Bald Mountain copper project.

During the year, the legislature transferred provisions affecting reclamation of mined lands to the Site Location of Development Act. Previously, certain mine workings were exempt from reclamation requirements. However, the transfer terminated the reclamation exemption, established a mechanism for the State to acquire mined land for reclamation purposes, and established a reclamation fund under the Department of Environmental Protection.

In 1978, Maine's plan for managing coastal lands and waters under the Federal Coastal Zone Management Act was approved by the U.S. Department of Commerce. The plan will regulate development, including mining, in the State's coastal zone.

Regulations and limitations on nonpoint source water pollution from mineral extraction and/or processing facilities were established in a regional waste-water treatment plan developed by the State. The development of the plan was required under Section 208 of the 1972 Federal Water Pollution Control Law.

The Maine Geological Survey is the principal State agency involved with mineral resources. During 1978 and 1979, the agency conducted seismic-tectonic studies for powerplant siting in various areas of the State. The work, requested by the Nuclear

Regulatory Agency, was approximately two-thirds complete at the end of 1979. Research with the U.S. Geological Survey (USGS) continued on rock mechanics of Holocene sediments. Discovery of the copper-zinc ore body in Aroostook County stimulated increased bedrock mapping in the area. In conjunction with the USGS, the Maine Geological Survey began quantitative and qualitative studies of Maine's peat resources as a potential fuel source.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—The Thomaston facility of Martin Marietta Corp., the only cement plant in New England, produced general-use and high-early-strength cement, most of which was sold in Maine, New Hampshire, and eastern Massachusetts. Leading consumers included ready-mix concrete companies, concrete product manufacturers, and building material dealers.

Clays.—During 1978 and 1979, six companies produced clay from a four-county area along Maine's coast. Clay was used in the manufacture of brick and cement.

Feldspar.—Although Oxford Feldspar Corp. terminated operations in 1977, a small quantity of material was sold from stockpile in 1978. The company had been shipping to Massachusetts and New York, where the feldspar was used in the manufacture of ceramic insulators.

Garnet.—In 1979, Industrial Garnet Extractives, Inc., West Paris, opened a mine in Oxford County in the southwestern part of the State. When fully operational, the mine will employ about 10 people during the spring-to-fall operating season.

Gem Stones.—The collection and sale of minerals and gem stones continued to be a small, but important, part of Maine's mineral economy. Value of gem and mineral specimens from Maine localities, sold on the open market, were estimated to represent several thousand dollars. The Plumbago Mining Corp. continued work on their property at Mount Mica in western Maine. Minerals from this deposit, first mined in 1822, are included in the crown collection in Sweden and in the imperial collection in Vienna. During 1978 and 1979, the company discovered a number of gem-bearing pockets containing numerous large quartz, beryl, and tourmaline crystals.

Peat.—Deer Hill Farms, Inc., Down East Peat Co., and International Peat Moss Co. produced peat from bogs in Maine's coastal area. The material was sold as a soil conditioning medium.

Perlite.—Crude perlite, imported from New Mexico, was expanded by Chemrock Co. at the company's plant near Thomaston. Most of the expanded perlite was sold to Marine Colloids, Inc., for use as a filter aid in the recovery of carragheen from sea weed.

Sand and Gravel.—Sand and gravel was again the leading mineral commodity produced in Maine in terms of value in 1978 and 1979, and was the only commodity produced in each of the State's 16 counties. During 1978, 141 companies produced sand and gravel from 154 operations; in 1979, two more companies were in operation and production was reported from 154 pits.

Penobscot, Cumberland, and York Counties were the leaders in output for both years. Principal end uses were for roadbase, fill, and asphalt aggregate.

Stone.—The State's crushed stone industry produced over 2 million tons of stone in 1979, an increase of approximately 400,000 tons over that of 1978. Limestone was the leading type produced, followed by sandstone, traprock, and marl.

Limestone was produced by six operations in three counties: Aroostook County in northern Maine, and Kennebec and Knox Counties in the southwestern part of the State. Although output was essentially stable during the 2 years, limestone's share of the market decreased from 68% to 55% because of an increase in sandstone output. Major uses were for aggregate and cement manufacture.

One company produced sandstone from two operations in Cumberland County in the southwestern part of Maine. Crushed sandstone output in 1979 increased over 50% because of the demand for concrete and bituminous aggregate; this use accounted for over 95% of sales.

Traprock was produced in Cumberland County; one company operated two mines in 1978, and one mine in 1979. Approximately 95% of the output was sold for concrete aggregate, and the remainder for riprap, jetty stone, and asphalt filler.

In 1979, one company produced granite in

Table 4.—Maine: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,579	$3,624	$2.30	1,999	$5,128	$2.57	1,069	$2,720	$2.55
Plaster and gunite sands	NA	NA	NA	--	--	--	--	--	--
Concrete products	779	2,085	2.68	W	W	2.57	W	W	2.50
Asphaltic concrete	1,509	3,026	2.01	1,594	3,535	2.22	2,061	4,608	2.24
Roadbase and coverings	3,553	5,967	1.68	4,009	6,572	1.64	4,285	6,596	1.54
Fill	2,289	3,259	1.42	2,135	3,301	1.55	2,173	3,565	1.64
Snow and ice control	NA	NA	NA	614	877	1.43	715	1,046	1.46
Railroad ballast	15	24	1.64	73	239	3.26	64	228	3.53
Other uses	763	1,038	1.36	1,101	2,814	2.56	656	1,771	2.70
Total[1] or average	10,487	19,023	1.81	11,530	22,470	1.95	11,022	20,534	1.86

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Data may not add to totals shown because of independent rounding.

Table 5.—Maine: Construction sand and gravel sold or used by producers

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	3,980	$7,218	$1.81	4,697	$8,645	$1.84	4,714	$9,084	$1.93
Gravel	6,507	11,806	1.81	6,828	13,821	2.02	6,308	11,450	1.82
Total[1] or average	10,487	19,023	1.81	11,530	22,470	1.95	11,022	20,534	1.86

[1] Data may not add to totals shown because of independent rounding.

York County in the southwestern part of Maine. Approximately 30,000 tons was produced and sold for riprap and jetty stone.

Marl was produced by one mine in Aroostook County. Production increased significantly in 1979, with the stone used for agricultural applications.

METALS

Copper.—Kerramerican, Inc., the last copper producer in Maine, closed the Blue Hill mine in Hancock County in October 1977. However, the discovery of a major copper-zinc ore body on Bald Mountain, Aroostook County, has encouraged exploration by various companies.

The Bald Mountain deposit was leased from Great Nekoosa Paper Co. by Superior Oil Co. and Louisiana Land and Exploration Co. During the biennium, additional core drilling, environmental baseline studies, and metallurgical tests were conducted. These predevelopment activities are scheduled for completion by mid-1980. The deposit is estimated to contain a minimum of 37 million tons of copper- and zinc-bearing mineralization in two major ore types. One ore type averages 3.38% zinc and 0.11% copper; the second, 1.63% copper and 0.22% zinc. Both contain traces of silver and gold. Preliminary metallurgical studies indicate there may be problems with metal recovery.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

[2] Maine State geologist and director, Maine Geological Survey, Augusta, Maine.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Martin Marietta Cement Corp., Eastern Div.[1]	6801 Rockledge Dr. Bethesda, MD 20034	Quarry and plant	Knox.
Clays:			
Dennis Brick Co., Inc	Mt. B Washington St. Auburn, ME 04210	Pit and mill	Androscoggin.
LaChance Brick Co., a division of Morin Brick Co.	Mosher Rd. Gorham, ME 04038	do	Cumberland.
Morin Brick Co	Danville, ME 04223	do	Androscoggin.
Rowantrees, Inc	Union St. Blue Hill, ME 04614	Pit	Hancock.
Royal River Brick Co., Inc	Box 191 Gray, ME 04039	Pit and mill	Cumberland.
Peat:			
Deer Hill Farms, Inc	Weeks Mills, ME 04361	Bog	Waldo.
Down East Peat Co	Star Route Deblois, ME 04622	Bog and plant	Washington.
International Peat Moss Co., Inc	430 Trapelo Rd. Belmont, MA 02178	do	Do.
Perlite (expanded):			
Chemrock Corp	End of Osage St. Nashville, TN 37208	Plant	Knox.
Sand and gravel:			
Blue Rock Industries	58 Main St. Westbrook, ME 04092	5 pits and mills	Androscoggin, Cumberland, Franklin, York.
Cianbro Corp	Box D Pittsfield, ME 04967	7 pits and mills	Franklin, Hancock, Oxford, Penobscot, Somerset.
G. E. Goding & Son, Inc	Route 1, Box 78A Lincoln, ME 04457	2 pits and plants	Penobscot.
D. J. Gurney, Inc	Route 1, River Rd. Waterville, ME 04901	2 pits and mills	Kennebec and Somerset.
George C. Hall Excavating	Box 506 Rockland, ME 04841	2 pits and plant	Knox.
Lane Construction Corp	965 East Main St. Bangor, ME 04401	4 pits and mills	Aroostook, Penobscot, Waldo, Washington.
Harold C. MacQuinn, Inc	Bar Harbor, ME 04609	Pit and mill	Hancock.
R. Pepin & Son, Inc	Route 1, Box 547 Sanford, ME 04073	do	York.
Portland Sand and Gravel Co., Inc	Gray Rd. Cumberland, ME 04021	do	Cumberland.
H. E. Sargent, Inc	101 Bennoch Rd. Stillwater, ME 04489	7 pits and mills	Kennebec, Penobscot, Sagadahoc, Somerset.
Warren Bros. Co	Fairfield, ME 04937	5 pits and mills	Cumberland, Penobscot, Somerset, York.
Stone:			
Granite, dimension:			
The John Swenson Granite Co., Inc.	North State St. Concord, NH 03301	3 quarries	Hancock and York.
Limestone, crushed:			
Blue Rock Industries	58 Main St. Westbrook, ME 04092	do	Cumberland and Kennebec.
Lane Construction Corp	965 East Main St. Bangor, ME 04401	Quarry	Aroostook.
Lime Products Corp	Box 357 Union, ME 04862	Quarry and mill	Knox.
Marl:			
Stanley Giles	17 Mechanic Rd. Presque Isle, ME 04769	do	Aroostook.
Miscellaneous stone:			
Cook Concrete Co	960 Ocean Ave. Portland, ME 04103	Quarry	Cumberland.
Thomas DiCenzo, Inc	75 Barker St. Calais, ME 04619	do	Washington.
Hughes Bros., Inc	Box 565 Bangor, ME 04401	2 pits and mill	Penobscot and Waldo.
Slate:			
Portland-Monson Slate Co	Monson, ME 04464	Underground mine and plant.	Piscataquis.

[1] Portland and masonry.

The Mineral Industry of Maryland

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Maryland Geological Survey for collecting information on all nonfuel minerals.

By William Kebblish[1]

The value of Maryland's mineral production in 1979 totaled $193 million, reflecting a substantial increase over the 1978 production value of $165 million. This overall increase was due to increases in both the production and value of stone, sand and gravel, and cement.

Stone and sand and gravel were the most valuable nonfuel mineral commodities produced in the State, followed by portland and masonry cement; all contributed significantly to the State's economy.

Table 1.—Nonfuel mineral production in Maryland[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2] thousand short tons	893	$2,344	948	$2,642	975	$2,854
Lime do.	W	W	12	436	12	444
Peat do.	3	W	3	W	3	W
Sand and gravel do.	11,702	29,562	13,310	34,950	13,968	39,033
Stone:						
Crushed do.	16,736	49,772	19,427	66,263	21,561	80,550
Dimension do.	30	908	28	1,048	30	1,150
Combined value of cement, clays (ball clay), gem stones (1977), and values indicated by symbol W	XX	50,405	XX	59,296	XX	68,931
Total	XX	132,991	XX	164,635	XX	192,962

W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes ball clay; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Maryland, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Allegany	$1,089	W	Stone.
Anne Arundel	4,066	$4,996	Sand and gravel.
Baltimore[2]	W	W	Stone, sand and gravel, clays.
Caroline	W	W	Sand and gravel.
Carroll	W	W	Cement, stone, clays.
Cecil	[r]8,927	10,996	Stone, sand and gravel.
Charles	W	3,910	Sand and gravel.
Dorchester	W	W	Do.
Frederick	W	W	Cement, stone, clays, lime.
Garrett	W	W	Stone, sand and gravel, peat.
Harford	W	3,540	Stone, sand and gravel.
Howard	2,406	1,881	Stone.
Kent	19	W	Clays.
Montgomery	6,065	W	Stone.
Prince Georges	12,125	13,679	Sand and gravel, clays.
Queen Annes	W	W	Stone.
St. Marys	451	398	Sand and gravel.
Washington	W	W	Cement, stone, clays.
Wicomico	W	W	Sand and gravel.
Worcester	695	1,048	Do.
Undistributed[3]	97,151	124,182	
Total[4]	132,991	164,635	

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1]Calvert, Somerset, and Talbot Counties are not listed because no production was reported.

[2]Includes Baltimore City.

[3]Includes gem stones and values indicated by symbol W.

[4]Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Maryland business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	1,944.0	2,032.0	2,092.0	+3.0
Unemployment	do.	118.0	114.0	123.0	+7.9
Employment (nonagricultural):					
Mining[1]	do.	(2)	(2)	(2)	--
Manufacturing	do.	235.1	242.0	245.7	+1.5
Contract construction	do.	92.2	102.5	104.1	+1.6
Transportation and public utilities	do.	80.9	84.6	87.2	+3.1
Wholesale and retail trade	do.	368.4	378.6	382.5	+1.0
Finance, insurance, real estate	do.	82.8	85.6	89.2	+4.2
Services	do.	[3]305.4	[3]317.3	[3]331.2	+4.4
Government	do.	374.3	383.0	380.2	-.7
Total nonagricultural employment[1]	do.	1,539.1	1,593.6	1,620.1	+1.7
Personal income:					
Total	millions	$31,519	$34,582	$37,955	+9.8
Per capita		$7,619	$8,348	$9,150	+9.6
Construction activity:					
Number of private and public residential units authorized		30,431	[4]30,442	26,056	-14.4
Value of nonresidential construction	millions	$439.0	$647.3	$678.9	+4.9
Value of State road contract awards	do.	$98.0	$53.0	$100.6	+89.8
Shipments of portland and masonry cement to and within the State	thousand short tons	1,368	1,512	1,480	-2.1
Nonfuel mineral production value:					
Total crude mineral value	millions	$133.0	$164.6	$193.0	+17.2
Value per capita, resident population		$32	$40	$47	+17.5
Value per square mile		$12,597	$15,595	$18,244	+17.0

[p]Preliminary.

[1]Includes bituminous coal and gas extraction.

[2]Included in "Services."

[3]Includes "Mining."

[4]Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines

Trends and Developments.—Studies have indicated that shortages of sand and gravel will develop in the Baltimore area within the next 35 years due to economic growth and the conversion of agricultural and mineral lands for other uses. In 1979, the Maryland Geological Survey compiled maps showing lands with potential sand and gravel deposits in Cecil, Harford, Baltimore, Anne Arundel, Howard, and Prince Georges Counties. These maps also indicate resources that have been preempted by development, government ownership, zoning restrictions, or other legal regulations. It was anticipated that land use planners, as well as the mining industry, will use this information to minimize future land use conflicts.

Employment.—A total of 2,705 workers was employed in Maryland's nonfuel mining industry in 1978. The stone industry was the leading employer in this sector, with 1,546 workers, including 487 cement industry employees. Sand and gravel operations employed 832 workers, and other nonmetallic mining operations employed 327 workers.

Legislation and Government Programs.—As of July 1, 1979, the Tidewater Administration began functioning within the Department of Natural Resources. The Administration coordinates and assumes responsibility for activities affecting the Chesapeake Bay. Included within the Administration is the former Coastal Zone Management Unit, which received Federal approval of the State's Coastal Zone Management Program on September 30, 1978.

An aeromagnetic map of the State on a scale of 1:250,000 was published through a cooperative effort of the U.S. Geological Survey and the Maryland Geological Survey. It is expected that this map will aid in interpreting geology and exploring for new mineral deposits. Other geophysical maps cover parts of Queen Annes, Dorchester, Kent, Cecil, Harford, and Baltimore Counties.

On October 20, 1978, the Bureau of Mines' Avondale Research Center was dedicated in Avondale, Md., about 6 miles from downtown Washington, D.C. The new site was obtained as a replacement for the Bureau's former College Park (Maryland) Metallurgy Research Center. Research at the center includes efforts to advance the technology of flotation for low-grade ores; identifying, recovering, and refining metals from scrap, industrial wastes, and urban refuse; and investigating ways to protect alloys from oxidation, corrosion, and water.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Production of portland cement reached an alltime high in Maryland in 1979 that was just slightly more than the previous production record established in 1978. Masonry cement production also continued to increase; 1979 production was slightly ahead of that of 1978. The average unit value for both types of cement increased each year since 1977. Four companies located in three counties produced portland cement; one company also produced masonry cement.

Raw materials used in making portland cement included limestone, cement rock, clay and shale, sand, gypsum, and ironbearing materials.

Clays.—Both the production and value of clay in 1979, excluding ball clay, were slightly higher than the 948,000 short tons of common clay and shale, valued at $2.64 million, that was produced in 1978. In 1979, about 67% of the State's clay and shale output was used to manufacture portland cement; the remaining 33% was used for common and face brick. Seven companies with 10 operations were located in 6 counties. Frederick County, with three operations, was the leading producer, followed by Carroll and Washington Counties. Ball clay was produced in Baltimore County and was used mainly for crockery and other earthenware.

Gem Stones.—Gem stones and mineral specimens were collected principally by amateurs, and the estimated value of these stones and minerals totaled less than $1,000 in 1979.

Gypsum.—Gypsum mined in other States was shipped into Maryland and calcined by National Gypsum Co. and United States Gypsum Co. in Baltimore. Both production and value in 1979 increased slightly over 1978 levels. Calcined gypsum was used mainly for prefabricated products such as regular wallboard, fire-resistant type X wallboard, and lath.

Lime.—S. W. Barrick & Sons, Inc., Frederick County, was the only lime producer in the State. Nearly 60% of the lime produced was quicklime; the remainder was hydrate. The lime output was used chiefly for agricultural purposes and was consumed mainly in Maryland.

Peat.—Garrett County Processing & Packaging Corp., in the western part of the State, was the only producer of peat. Both production and value remained relatively unchanged in 1978 and 1979. Peat was used mainly for soil improvement.

Perlite.—Prior to 1979, perlite was imported into the State and expanded in one plant in Baltimore. In 1979, production ceased because adequate supplies of the processed product were available from surrounding States. Expanded perlite was used as an aggregate in plaster and for horticultural purposes.

Sand and Gravel.—The production and value of construction sand and gravel in 1979 increased slightly over the 13.3 million short tons, valued at nearly $35 million, that was produced in 1978. No industrial sand was produced in the State.

In 1979, sand and gravel was produced in 12 of the State's 23 counties by 46 companies from 52 deposits. Leading producing counties were Prince Georges, Anne Arundel, and Cecil, all located near the highly industrialized areas of the State. Sand and gravel was used in building construction, paving, concrete products, and as fill.

Slag.—In 1979, Maryland was one of the 10 leading slag-producing States in the Nation. Iron blast-furnace slag, a byproduct of the steelmaking process, was produced in the Baltimore area. Of the total output, 70% was air-cooled slag and 30% was expanded slag. Air-cooled slag was used mainly in highway construction, and expanded slag, which is lightweight and has high fire resistance, was used for lightweight concrete blocks.

Table 4.—Maryland: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	5,812	$15,581	$2.68	7,068	$19,867	$2.81	6,203	$18,177	$2.93
Plaster and gunite sands	NA	NA	NA	32	100	3.11	W	W	W
Concrete products	1,635	4,182	2.54	1,335	3,275	2.45	1,311	3,418	2.61
Asphaltic concrete	2,206	5,122	2.32	2,449	5,684	2.32	3,335	9,443	2.83
Roadbase and coverings	955	1,699	1.78	1,286	2,641	2.05	1,631	4,157	2.55
Fill	585	1,217	2.08	659	1,515	2.30	1,007	1,895	1.88
Snow and ice control	NA	NA	NA	W	W	W	4	9	2.06
Other uses	507	1,781	3.51	477	1,866	3.91	499	1,935	3.88
Total[1] or average	11,702	29,562	2.53	13,310	34,950	2.63	13,988	39,033	2.79

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Table 5.—Maryland: Construction sand and gravel sold or used by producers

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	7,080	$16,919	$2.39	7,808	$19,729	$2.53	8,024	$21,326	$2.66
Gravel	4,622	12,644	2.74	5,499	15,218	2.77	5,965	17,707	2.97
Total[1] or average	11,702	29,562	2.53	13,310	34,950	2.63	13,988	39,033	2.79

[1] Data may not add to totals shown because of independent rounding.

Stone.—Stone was Maryland's leading mineral commodity in 1979. Both production and value exceeded the 19.5 million short tons, valued at $67.3 million, that was produced in 1978.

In 1979, 36 quarries were operating in 11 of the State's 23 counties. Crushed stone was produced from 31 quarries, dimension stone was produced from 6 quarries, and one quarry produced both types. Leading counties for the production of crushed stone were Baltimore, Frederick, Montgomery, and Carroll, all located north of Washington, D.C.

Dimension stone was produced in Baltimore, Garrett, Howard, and Montgomery Counties. Nearly 70% of the the dimension stone quarried was sandstone; the remainder was mica schist.

Eight of the State's 36 quarries each produced over 900,000 short tons of stone annually, accounting for 67% of the total production in 1979 and 64% in 1978. There was a general trend toward fewer quarries with larger production due to local zoning ordinances, environmental regulations, and market locations.

Crushed stone was used primarily for roadstone, aggregate, and cement manufacture. Dimension stone was used mainly for flagging, structural shapes, roofing, and flooring.

Table 6.—Maryland: Construction sand and gravel sold or used, by county

(Thousand short tons and thousand dollars)

County	1977			1978			1979		
	Quantity	Value	Number of companies	Quantity	Value	Number of companies	Quantity	Value	Number of companies
Anne Arundel	2,076	4,066	15	2,199	4,996	12	1,899	4,382	8
Baltimore	1,502	4,446	3	1,514	4,468	3	W	W	2
Caroline	W	W	1	W	W	1	17	29	1
Cecil	1,895	4,013	3	1,973	4,224	3	1,966	4,214	3
Charles	W	W	2	1,344	3,910	3	1,394	3,938	3
Dorchester	W	W	2	W	W	2	W	W	2
Garrett	W	W	2	41	W	1	W	W	1
Harford	758	1,744	5	753	1,735	5	503	1,623	5
Prince Georges	4,189	11,927	11	4,539	13,456	11	5,381	18,075	12
St. Marys	223	451	4	217	398	3	328	531	3
Wicomico	W	W	1	W	W	1	W	W	1
Worcester	407	695	4	539	1,048	5	470	804	5
Total[1]	11,702	29,562	53	13,310	34,950	50	13,988	39,033	46

W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Table 7.—Maryland: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate	[r]2,164	[r]6,480	2,418	8,320	2,704	9,376
Bituminous aggregate	2,378	6,488	2,505	7,799	2,833	9,450
Macadam aggregate	1,667	4,203	1,807	6,085	2,266	7,404
Dense-graded roadbase stone	1,724	4,423	1,346	3,967	1,439	4,955
Surface treatment aggregate	330	981	337	1,162	436	1,442
Other construction aggregate and roadstone	5,036	14,670	6,299	18,904	7,171	23,800
Riprap and jetty stone	219	787	269	1,026	310	1,252
Railroad ballast	116	280	175	405	108	276
Manufactured fine aggregate (stone sand)	249	800	251	1,056	204	726
Cement manufacture	2,062	2,581	2,351	3,519	2,477	3,934
Lime manufacture	27	68	25	74	23	74
Other uses[2]	765	8,011	1,645	13,947	1,589	17,860
Total[3]	16,736	49,772	19,427	66,263	21,561	80,550

[r] Revised.

[1] Includes limestone, granite, sandstone, shell, traprock, and miscellaneous stone.

[2] Includes stone used for agricultural limestone, agricultural marl and other soil conditioners, poultry grit and mineral food, flux stone (1979), refractory stone, abrasives (1977-78), mine dusting, asphalt filler, whiting, other filler, and other miscellaneous uses.

[3] Data may not add to totals shown because of independent rounding.

Talc.—Harford Talc Co. ceased mining in Harford County in 1974. However, during 1978 and 1979, the company purchased talc from other States and from foreign countries and processed it for use in the manufacture of electrical insulators.

Vermiculite (Exfoliated).—W. R. Grace & Co.'s Muirkirk plant, Prince Georges County, exfoliated vermiculite produced in other States. Production and value in 1979 were slightly higher than in 1978. Exfoliated vermiculite was used mainly for concrete aggregate and fireproofing.

METALS

Aluminum.—Although no alumina-bearing ores were mined in Maryland, imported ores were used in the production of aluminum. Eastalco Aluminum Co., Frederick County, owned by Howmet Aluminum Corp. and Alumax, Inc., was the State's largest producer of primary aluminum. Eastalco had planned to increase its output by 50% through construction of a third potline, but plans were canceled due to Potomac Edison Electric Co.'s inability to provide the necessary electric power. Other producers of primary aluminum were Tomke Aluminum Co. and Cambridge Iron and Metal Co., Inc., both located in Baltimore.

Copper.—Although copper was not mined in the State, Kennecott Refining Co. operated a refinery at Hawkins Point, south east of Baltimore.

Iron Oxide Pigments.—Mineral Pigments Corp., Beltsville, Prince Georges County, was the only producer of natural and synthetic iron oxide pigments. Principal uses were in paints, rubber, plastics, paper, magnetic ink, and fertilizers.

Iron and Steel.—Bethlehem Steel Corp., Sparrows Point, near Baltimore, produced pig iron, raw steel, and semifabricated steel products from imported ore.

Bethlehem's new $200 million blast furnace, officially dedicated in late 1978, is the largest and most modern blast furnace in the Western Hemisphere. The computer-operated furnace, designated as Furnace "L" by the company, was designed to produce 8,000 short tons of pig iron daily. In operation, the design output was exceeded by 25%, setting a single-day company record. A monthly production of 270,000 short tons in December 1979 also established a new North American record. Furnace "L" stands 300 feet above ground level and replaces four older blast furnaces.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Portland:			
Alpha Portland Cement Co.[1]	15 South 3d St. Easton, PA 18042	Plant and quarry.	Frederick.
Lehigh Portland Cement Co.[2]	718 Hamilton St. Allentown, PA 18101	do	Carroll.
Portland and masonry:			
Marquette Cement Manufacturing Co.[1]	First American Center Nashville, TN 37238	do	Washington.
Clays:			
Baltimore Brick Co	501 St. Paul Pl. Baltimore, MD 21202	Pits	Baltimore and Frederick.
Victor Cushwa & Sons, Inc	Box 228 Williamsport, MD 21795	Pit	Washington.
Cyprus Industrial Materials Co	555 South Flower St. Los Angeles, CA 90071	Pit	Baltimore.
Gypsum (calcined):			
National Gypsum Co	4100 First International Bldg. Dallas, TX 75270	Plant	Do.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Do.
Iron oxide pigments (finished, natural and manufactured):			
Minerals Pigments Corp	7011 Muirkirk Rd. Beltsville, MD 20705	do	Prince Georges.
Lime:			
S. W. Barrick & Sons, Inc.[1]	Woodsboro, MD 21798	do	Frederick.
Peat:			
Garrett County Processing & Packaging Corp.	Route 1 Accident, MD 21520	Bog	Garrett.
Sand and gravel:			
Campbell Sand & Gravel, Inc	4911 Calvert Rd. College Park, MD 20740	Pit	Prince Georges.
Harry T. Campbell Sons Co., a division of The Flintkote Co.[1]	White Marsh Plant Towson, MD 21225	Pits	Baltimore.
Charles City Sand & Gravel Co., Inc	Waldorf Industrial Center Box 322 Waldorf, MD 20601	Dredges	Charles.
Contee Sand & Gravel Co., Inc	Box 460 Laurel, MD 20810	Pit	Prince Georges.
York Building Products Co., Inc	Box 1708 York, PA 17405	Pit	Cecil.
Stone:			
Arundel Corp	501 St. Paul Pl. Baltimore, MD 21202	Quarries	Baltimore and Howard.
Martin-Marietta Aggregates	66 Long Clove Rd. Congers, NY 10920	Quarry	Washington.
Maryland Materials, Inc.	Box W North East, MD 21901	do	Cecil.
Rockville Crushed Stone, Inc	Box 407 Rockville, MD 20850	do	Montgomery.
D. M. Stoltzfus & Sons, Inc	Talmage, PA 17580	Quarries	Cecil.

[1] Also stone.
[2] Also clays and stone.

The Mineral Industry of Massachusetts

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Massachusetts Department of Environmental Quality, Office of the State Geologist, for collecting information on all nonfuel minerals.

By Doss H. White, Jr.[1] and Joseph A. Sinnott[2]

The value of mineral production in Massachusetts was $90.1 million in 1978 and $92.5 million in 1979. Mining in the State dates from around 1643, when iron ore was produced to feed a blast furnace erected at Hammersmith, near Lynn, on the west bank of the Saugas River. Although this venture flourished for only a few years, it served as an early prototype of American heavy industry.

Since then, mineral production in Massachusetts has changed from metals to industrial minerals. In 1978-79, the leading mineral commodities mined in-State were stone and sand and gravel. Other commodities produced included clays, shale, lime, and peat. Gypsum, perlite, and vermiculite mined out-of-State were imported for processing.

Table 1.—Nonfuel mineral production in Massachusetts[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	149	$275	155	$333	156	$367
Lime do	W	W	199	8,478	198	9,918
Peat do	2	W	2	65	2	56
Sand and gravel do	16,639	34,346	[2]17,860	[2]37,460	[2]16,705	[2]37,164
Stone:						
Crushed do	8,030	30,501	8,398	36,360	8,586	39,570
Dimension do	63	4,856	68	6,411	48	4,389
Combined value of other nonmetals and values indicated by symbol W	XX	7,290	XX	961	XX	1,082
Total	XX	77,268	XX	90,068	XX	92,546

W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Massachusetts, by county

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Barnstable	$1,603	$1,720	Sand and gravel.
Berkshire	W	W	Stone, lime, sand and gravel.
Bristol	6,730	7,404	Stone, sand and gravel.
Dukes	98	107	Sand and gravel.
Essex	6,965	7,501	Stone, sand and gravel.
Franklin	1,617	W	Sand and gravel, stone.
Hampden	4,700	W	Do.
Hampshire	W	W	Do.
Middlesex	15,541	19,303	Stone, sand and gravel.
Nantucket	100	100	Sand and gravel.
Norfolk	W	W	Stone, sand and gravel, clays.
Plymouth	W	W	Sand and gravel, clays, stone.
Suffolk	W	W	Stone.
Worchester	W	9,119	Sand and gravel, stone, peat.
Undistributed[1]	39,912	44,816	
Total[2]	77,268	90,068	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes gem stones and values indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Massachusetts business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	2,776.0	2,835.0	2,891.0	+2.0
Unemployment	do	225.0	173.0	160.0	-7.5
Employment (nonagricultural):					
Mining	do	(1)	(1)	(1)	--
Manufacturing	do	621.0	652.4	670.3	+2.7
Contract construction	do	66.7	72.8	76.6	+5.2
Transportation and public utilities	do	114.9	117.3	120.1	+2.4
Wholesale and retail trade	do	533.7	547.3	567.4	+3.7
Finance, insurance, real estate	do	143.2	146.7	148.2	+1.0
Services	do	[2]528.6	[2]560.8	[2]596.2	+6.3
Government	do	397.0	429.2	420.1	-2.1
Total nonagricultural employment	do	2,405.1	2,526.5	2,598.9	+2.9
Personal income:					
Total	millions	$41,608	$45,765	$51,019	+11.5
Per capita		$7,202	$7,926	$8,844	+11.6
Construction activity:					
Number of private and public residential units authorized		21,978	[3]21,486	19,957	-7.2
Value of nonresidential construction	millions	$482.0	$493.9	$705.7	+42.9
Value of State road contract awards	do	$120.0	$140.0	NA	--
Shipments of portland and masonry cement to and within the State	thousand short tons	895	1,022	1,047	+2.4
Nonfuel mineral production value:					
Total crude mineral value	millions	$77.3	$90.1	$92.5	+2.7
Value per capita, resident population		$13	$16	$16	--
Value per square mile		$9,358	$10,908	$11,208	+2.6

[p] Preliminary. NA Not available.

[1] Included with "Services."

[2] Includes mining.

[3] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Trends and Developments.—From 1970 to 1979, the value of Massachusetts' mineral production increased more than 60%. Only in 1971 and 1975 did the value fall below that of the previous year. These decreases were the result of a mild recession that carried over from 1970 and a deep recession in 1974 that continued into 1975.

In spite of a limited mineral resource base, much of Massachusetts' industry was involved in processing and refining mineral raw materials. Although only a small fraction of the State's 2 million industrial workers was employed in primary mineral extraction, approximately 18% was involved in industries that were either entirely or partially dependent on mineral-derived products. Much of the income of the State's trucking and rail lines was generated from transporting dimension and crushed stone, lime, sand and gravel, and gypsum. Of the mineral- and fuel-related products passing through the Port of Boston, 48% was metallic or nonmetallic minerals and primary or scrap metals.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—There are no cement manufacturing plants in the State. In 1978, Massachusetts imported 982,000 tons of cement. In 1979, imports totaled over 1 million tons. The eastern part of the State received cement shipments from Maine, and the rest of the State imported cement from other Northeastern States.

Clays.—The State's clay and shale industry was centered in Norfolk and Plymouth Counties in eastern Massachusetts. Two companies mined common clay for brick manufacture and a third mined anthracite-bearing shales in Plymouth County as a raw material in the manufacture of lightweight aggregate.

Gem Stones.—Gem stones and mineral specimens played a small but significant role in the State's mineral economy. Crystal Systems, in Salem, produced the world's largest synthetic sapphire crystals, which are used in such optical applications as lenses and high-impact windows. Research is ongoing into the mechanical application of synthetic sapphire for wear-resistant surfaces. Mineral collecting was also a popular pastime in Massachusetts.

Gypsum.—Crude gypsum, mined by two subsidiaries in New Brunswick and Nova Scotia, Canada, was imported by United States Gypsum Co. at a calcining facility near Boston. The principal use of gypsum calcined in the State was in the manufacture of wallboard.

Lime.—Pfizer, Inc., and Lee Lime Corp. produced lime from locally mined material in Berkshire County in western Massachusetts. The lime was shipped within Massachusetts and to New York, Connecticut, and other States for use in the manufacture of animal foods, precipitated calcium carbonate, mason's lime, sewage treatment, and other applications.

Peat.—Reed sedge peat was produced by Sterling Peat Co., Worcester County, in north-central Massachusetts. The peat was used predominately for agricultural applications by nurserymen, landscapers, and greenhouse owners.

Perlite (Expanded).—Whittemore Products, Inc., expanded perlite mined in New Mexico at its facility in Suffolk County. Expanded perlite was used in lightweight aggregate and as a horticultural medium.

Sand and Gravel.—Production of construction and industrial sand and gravel was reported from 13 of the 14 counties in the State. During the 1978-79 biennium, the industry was comprised of more than 175 companies producing from over 185 deposits. Leading counties, in terms of output, were Worcester, Middlesex, and Norfolk. Construction sand and gravel was used primarily for aggregate, road base, and fill. Industrial sand was used by the foundry industry for moldings and castings.

Table 4.—Massachusetts: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	6,654	$15,754	$2.37	7,025	$17,400	$2.48	6,027	$16,622	$2.76
Plaster and gunite sands	NA	NA	NA	80	226	2.82	83	185	2.22
Concrete products	1,046	2,620	2.50	940	2,300	2.45	469	1,183	2.52
Asphaltic concrete	1,414	3,437	2.43	1,518	3,598	2.37	2,098	4,774	2.28
Roadbase and coverings	3,368	5,894	1.75	3,886	6,970	1.79	3,830	7,091	1.85
Fill	3,467	4,444	1.28	3,235	4,400	1.36	3,075	4,548	1.48
Snow and ice control	NA	NA	NA	850	1,863	2.19	713	1,444	2.03
Railroad ballast	W	W	W	2	6	2.76	--	--	--
Other uses	571	1,246	2.18	319	699	2.19	410	1,319	3.22
Total[1] or average	16,520	33,395	2.02	17,860	37,460	2.10	16,705	37,164	2.22

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Data may not add to totals shown because of independent rounding.

Table 5.—Massachusetts: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	6,912	$13,761	$1.99	7,674	$15,682	$2.04	7,138	$14,717	$2.06
Gravel	9,609	19,633	2.04	10,181	21,778	2.14	9,567	22,447	2.35
Total[1] or average	16,520	33,395	2.02	17,860	37,460	2.10	16,705	37,164	2.22
Industrial sand	119	951	7.99	W	W	W	W	W	W
Grand total[1]	16,639	34,346	2.06	W	W	W	W	W	W

W Withheld to avoid disclosing company proprietary data.

[1] Data may not add to totals shown because of independent rounding.

Stone.—During the biennium, more than 45% of the State's mineral production value came from the sale of crushed and dimension stone. Crushed stone was produced in all counties; dimension stone was quarried in four.

The crushed stone industry produced 8.6 million tons of traprock, granite, and limestone in 1979, an increase of approximately 200,000 tons over that of 1978. Traprock, which was produced from 26 operations in 9 counties in the central part of the State, accounted for approximately 77% of the crushed stone that was produced in the State during each of the 2 years. Three-quarters of the traprock was sold for aggregate and railroad ballast.

Crushed granite was produced in Middlesex, Norfolk, and Plymouth Counties in eastern Massachusetts. In 1979, output exceeded 1.1 million tons, an increase of 200,000 tons over that of 1978. Production in 1979 was from five quarries, one more than in the previous year. About four-fifths of the output was used for aggregate.

Crushed limestone was quarried in Berkshire County in the western part of the State. Output from three quarries active in 1979 was less than the 770,000 tons reported in 1978, a result of the closing of one quarry. Nine-tenths of the stone was used in the production of lime, agricultural limestone, and filler.

Dimension granite was quarried at seven operations in Middlesex, Norfolk, Plymouth, and Berkshire Counties. Output in 1979 was approximately 47,000 tons, a decrease of more than 25% from that of 1978. Four-fifths of the stone quarried in the two years was sold for curbstone, paving block, and rubble.

One company, in Berkshire County, produced dimension marble. Output in 1979 was 1,500 tons, an increase over that of

1978. Quarry-run blocks were trucked to Canada for finishing.

Vermiculite.—W. R. Grace & Co. imported and exfoliated vermiculite from out-of-State at its Easthampton plant in Hampshire County. Major uses were for loose-fill and block insulation and horticulture.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

[2] Massachusetts State geologist, Boston, Mass.

Table 6.—Massachusetts: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	134	996	150	1,157	W	W
Concrete aggregate	[r]293	[r]834	303	916	456	1,687
Bituminous aggregate	3,103	[r]10,705	2,924	11,292	2,910	11,622
Macadam aggregate	101	360	211	715	203	746
Dense-graded roadbase stone	760	2,194	609	1,991	755	2,603
Surface treatment aggregate	10	30	61	191	65	224
Other construction aggregate and roadstone	1,466	4,060	2,072	7,166	1,953	7,223
Riprap and jetty stone	81	216	131	381	106	304
Railroad ballast	752	1,615	688	2,073	790	2,644
Filter stone	245	818	W	W	W	W
Manufactured fine aggregate (stone sand)	339	878	286	766	277	706
Flux stone	W	W	5	46	6	55
Roofing granules	173	W	206	525	212	755
Other uses[2]	573	7,794	758	9,140	854	11,001
Total[3]	8,030	30,501	8,398	36,360	8,586	39,570

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, traprock, and miscellaneous stone.

[2] Includes stone used for poultry grit and mineral food, lime manufacture, asphalt filler, other filler, unspecified uses (1977), and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
K-F Brick Co., Inc.	River St. Middleboro, MA 02346	Pit	Plymouth.
Plainville Corp., Masslite Div.[1]	Box 327 Walpole, MA 02081	Pit	Norfolk.
Stiles & Hart Brick Co	Box 367 Bridgewater, MA 02324	Pit	Plymouth.
Gypsum, calcined:			
United States Gypsum Co.[2]	101 South Wacker Dr. Chicago, IL 60606	Plant	Suffolk.
Lime:			
Lee Lime Corp.[3]	Marble St. Lee. MA 01238	do	Berkshire.
Pfizer, Inc.[3]	260 Columbia St. Adams, MA 01220	do	Do.
Peat:			
Sterling Peat Co	Sterling Junction, MA 01565	Bog	Worcester.
Perlite, expanded:			
Whittemore Products, Inc.	35 Harrison St. Roslindale, MA 02131	Plant	Suffolk.
Sand and gravel:			
Assabet Sand and Gravel	Box 256 Acton, MA 01720	Pit	Middlesex.
J. J. Cronin Co	Box 176 North Reading, MA 01864	Pit	Do.
E. L. Dauphinais, Inc.	160 Worcester Rd. North Grafton, MA 01536	Pit	Worcester.
Hyannis Sand and Gravel	Box 96 Hyannis, MA 02601	Pit	Barnstable.
Marshfield Sand and Gravel, Inc	Clay Pit Rd. Marshfield, MA 02050	Pit	Norfolk.
Merrimack Paving Corp.	Yemma Rd. Groveland, MA 01830	Pit	Essex.
Namasket Construction Co	Box 296 Middleboro, MA 02341	Pit	Plymouth.

See footnotes at end of table.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel —Continued			
A. A. Will Sand & Gravel Corp	Turnpike St. Canton, MA 02021	Pit	Norfolk.
Worcester Sand & Gravel Co	182 Holden St. Shrewsbury, MA 01545	Pit	Worcester.
Industrial:			
Holliston Sand Co., Inc	303 Lowland St. Holliston, MA 01746	Pit	Middlesex.
Southeastern Sand & Gravel, Inc	Kingston, MA 02364	Pit	Plymouth.
Whitehead Bros. Co	60 Hanover Rd. Florham Park, NJ 07932	Pit	Do.
Stone:			
G. Brox, Inc	1471 Methuen St. Dracut, MA 01826	Quarry	Middlesex.
Essex Bituminous Concrete, Inc	55 Russel St. Peabody, MA 01960	do	Essex and Middlesex.
H. E. Fletcher Co	West Chelmsford, MA 01863	do	Middlesex and Worcester.
P. J. Keating Co	Box 367 Fitchburg, MA 01420	do	Worcester.
John S. Land & Son, Inc	Box 125 Westfield, MA 01085	do	Hampden and Hampshire.
Lynn Sand & Stone Co	30 Danvers Rd. Swampscott, MA 01907	do	Essex.
Massachusetts Broken Stone Co	133 Boston Post Rd. Weston, MA 02193	do	Middlesex.
Manchester Stone & Gravel Co	Box 402 Manchester, MA 01944	do	Essex.
Old Colony Crushed Stone Co	Box 230 Quincy, MA 02169	do	Norfolk.
Simeone Stone Corp	1185 Turnpike St. Stoughton, MA 02072	do	Do.
Trimount Bituminous Products Co.	1840 Revere Beach Parkway Everett, MA 02149	do	Essex.
Warren Bros. Co., a division of Ashland Oil & Refining Co., Inc.	430 Howard St. Brockton, MA 02402	do	Bristol.
Vermiculite, exfoliated:			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	Plant	Hampshire.

[1] Also sand and gravel.
[2] Also expanded perlite.
[3] Also stone.

The Mineral Industry of Michigan

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Geological Survey Division, Michigan Department of Natural Resources, for collecting information on all nonfuel minerals.

By James J. Hill[1] and L. J. Prosser, Jr.[2]

The value of nonfuel mineral production in Michigan was $1.4 billion in 1978 and $1.5 billion in 1979. Leading nonfuel mineral commodities, in terms of value, were iron ore, portland cement, sand and gravel, magnesium compounds, and stone. Iron ore production, in the decade of the 1970's, accounted for about 33% of the State's total nonfuel mineral value. During 1978 and 1979, Michigan was the Nation's leading producer of calcium chloride, crude gypsum, magnesium compounds, and peat. Other nonfuel mineral commodities produced were bromine, clay, copper, iodine, lime, masonry cement, salt, silver, and sulfur.

Table 1.—Nonfuel mineral production in Michigan[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:						
Masonry ---- thousand short tons	246	$9,761	294	$13,621	262	$16,456
Portland ---- do	5,582	166,803	5,916	211,786	5,682	252,058
Clays ---- do	2,007	5,126	2,122	6,993	2,072	7,430
Copper (recoverable content of ores, etc.) metric tons	38,442	56,613	W	W	W	W
Gem stones	NA	12	NA	10	NA	10
Gypsum ---- thousand short tons	1,924	8,778	2,765	15,526	2,526	14,633
Iron ore (usable), thousand long tons gross weight	12,009	356,227	17,538	556,954	17,196	596,478
Lime ---- thousand short tons	1,347	42,015	1,291	45,814	1,057	43,373
Peat ---- do	226	3,917	220	3,851	258	4,847
Salt ---- do	3,939	78,808	3,741	83,872	3,080	82,540
Sand and gravel ---- do	46,486	101,542	48,260	107,600	50,169	116,597
Silver (recoverable content of ores, etc.) thousand troy ounces	335	1,550	W	W	W	W
Stone:						
Crushed ---- thousand short tons	40,517	84,971	40,129	90,981	39,809	99,832
Dimension ---- do	8	147	8	155	9	166
Combined value of bromine, calcium chloride, iodine, magnesium compounds, and values indicated by symbol W	XX	138,626	XX	222,427	XX	272,057
Total	XX	1,054,896	XX	1,359,590	XX	1,506,476

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Michigan, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Alcona	$46	$30	Sand and gravel.
Alger	50	29	Do.
Allegan	W	W	Sand and gravel, stone, peat.
Alpena	W	W	Cement, stone, clays, sand and gravel.
Antrim	W	W	Clays, sand and gravel.
Arenac	1,231	1,229	Stone, sand and gravel.
Baraga	271	92	Sand and gravel.
Barry	905	297	Do.
Bay	12,881	16,157	Cement, sand and gravel, lime.
Benzie	45	100	Sand and gravel.
Berrien	7,050	6,716	Do.
Branch	W	W	Do.
Calhoun	959	712	Do.
Cass	1,082	W	Sand and gravel, stone.
Charlevoix	W	W	Cement, stone, sand and gravel.
Cheboygan	W	W	Sand and gravel, stone.
Chippewa	W	W	Stone, sand and gravel.
Clare	436	596	Sand and gravel.
Clinton	W	W	Sand and gravel, clays.
Crawford	73	--	
Delta	659	W	Sand and gravel, stone.
Dickinson	W	W	Iron ore, sand and gravel, stone.
Eaton	W	W	Stone, sand and gravel, peat.
Emmet	W	W	Cement, stone, clays, sand and gravel.
Genesee	W	414	Sand and gravel.
Gladwin	15	15	Do.
Gogebic	242	444	Do.
Grand Traverse	258	110	Do.
Gratiot	W	W	Magnesium compounds, calcium chloride, salt, sand and gravel.
Hillsdale	882	1,110	Sand and gravel.
Houghton	344	469	Sand and gravel, stone.
Huron	W	W	Stone, sand and gravel, lime.
Ingham	1,286	514	Sand and gravel, peat.
Ionia	195	194	Sand and gravel.
Iosco	W	W	Gypsum, sand and gravel.
Iron	W	W	Iron ore, sand and gravel.
Isabella	1,018	W	Sand and gravel.
Jackson	W	711	Sand and gravel, stone.
Kalamazoo	2,169	1,839	Sand and gravel.
Kalkaska	6	--	
Kent	W	W	Sand and gravel, gypsum, peat.
Keweenaw	--	--	
Lake	75	144	Sand and gravel.
Lapeer	W	2,238	Peat, sand and gravel.
Leelanau	W	W	Sand and gravel.
Lenawee	1,149	864	Do.
Livingston	3,113	2,859	Do.
Luce	120	28	Do.
Mackinac	14,919	16,459	Stone, sand and gravel.
Macomb	2,499	2,973	Sand and gravel.
Manistee	70,213	80,233	Magnesium compounds, salt, sand and gravel, bromine.
Marquette	W	W	Iron ore, sand and gravel, stone.
Mason	W	W	Calcium chloride, magnesium compounds, lime, bromine, sand and gravel.
Mecosta	W	W	Sand and gravel, peat.
Menominee	118	135	Sand and gravel.
Midland	W	W	Bromine, calcium chloride, magnesium compounds, iodine, salt.
Missaukee	248	W	Sand and gravel.
Monroe	35,209	43,413	Cement, stone, clays, peat.
Montcalm	1,004	509	Sand and gravel.
Montmorency	--	--	
Muskegon	W	W	Sand and gravel, salt.
Newaygo	W	W	Sand and gravel.
Oakland	20,238	22,827	Sand and gravel, peat.
Oceana	2,808	2,361	Sand and gravel.
Ogemaw	380	640	Do.
Ontonagon	58,388	53,153	Copper, silver, sand and gravel.
Osceola	530	430	Sand and gravel.
Oscoda	--	--	
Otsego	38	155	Sand and gravel.
Ottawa	5,138	3,844	Do.
Presque Isle	35,512	W	Stone, sand and gravel.
Roscommon	--	--	
Saginaw	W	W	Sand and gravel, lime.
St. Clair	W	W	Salt, sand and gravel.
St. Joseph	W	W	Sand and gravel, peat, stone.
Sanilac	W	W	Peat, sand and gravel, lime.
Schoolcraft	1,774	W	Stone, sand and gravel.
Shiawassee	W	W	Clays, peat, sand and gravel.
Tuscola	W	W	Sand and gravel, lime.
Van Buren	W	332	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Michigan, by county[1] —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Washtenaw	$3,319	$3,207	Do.
Wayne	91,494	W	Lime, cement, salt, sand and gravel, stone, clays.
Wexford	1,660	1,875	Sand and gravel.
Undistributed[1]	672,845	1,089,133	
Total[2]	1,054,896	1,359,590	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes gem stones, sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Michigan business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	4,124.0	4,198.0	4,314.0	+2.8
Unemployment	do	337.0	289.0	335.0	+15.9
Employment (nonagricultural):					
Mining	do	12.2	13.3	13.4	+.8
Manufacturing	do	1,105.6	1,179.6	1,151.1	-2.4
Contract construction	do	124.1	138.8	139.8	+.7
Transportation and public utilities	do	146.9	155.9	158.8	+1.9
Wholesale and retail trade	do	698.9	749.1	757.4	+1.1
Finance, insurance, real estate	do	139.5	147.4	153.3	+4.0
Services	do	570.3	613.8	631.1	+2.8
Government	do	614.1	608.4	622.9	+2.4
Total nonagricultural employment[1]	do	3,411.6	[2]3,608.5	3,627.8	+.5
Personal income:					
Total	millions	$69,534	$77,985	$85,341	+9.4
Per capita		$7,601	$8,487	$9,269	+9.2
Construction activity:					
Number of private and public residential units authorized		58,684	[3]61,074	49,480	-19.0
Value of nonresidential construction	millions	$817.2	$983.4	$1,148.0	+16.7
Value of State road contract awards	do	$280.0	$300.0	$193.1	-35.6
Shipments of portland and masonry cement to and within the State	thousand short tons	2,839	3,119	3,043	-2.4
Nonfuel mineral production value:					
Total crude mineral value	millions	$1,054.9	$1,359.6	$1,506.5	+10.8
Value per capita, resident population		$115	$147	$164	+11.6
Value per square mile		$18,120	$23,354	$25,877	+10.8

[p] Preliminary.

[1] Includes oil and gas extraction.

[2] Data do not add to total shown because of independent rounding.

[3] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Trends and Developments.—Exploration activity in Michigan's Upper Peninsula continued at a high pace during 1978 and 1979 because of increased interest in the mineral potential of the Precambrian shield. Several mining firms began to search for mineral commodities, concentrating on copper, iron, gold, and uranium. Although no new discoveries were announced, several exploration programs are continuing.

Cleveland-Cliffs Iron Co. and Chevron Resources Co., a subsidiary of Standard Oil of California, drilled a joint venture prospect for strata-bound copper just south of Marquette, in Marquette County, and evaluated other properties in the Upper Penin-

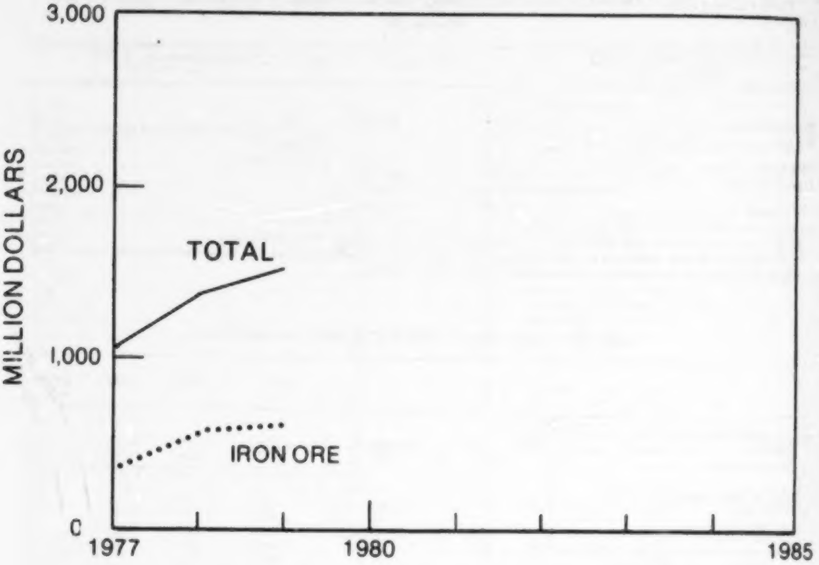

Figure 1.—Value of iron ore and total value of nonfuel mineral production in Michigan.

sula. Homestake Copper Co., a subsidiary of Homestake Mining Co., terminated exploration for native copper on the Keweenaw Peninsula after evaluating several undeveloped properties and a former producing mine.

Cleveland-Cliffs and Republic Steel Corp. continued drilling on the Cascade iron deposit near Palmer, in Marquette County, and Pickands, Mather & Co. conducted exploratory drilling near Iron Mountain, in Dickinson County. Last production from the Iron Mountain District was in 1959.

In 1979, with the rise in the price of gold, Callahan Mining Corp. began evaluating the long-inactive Ropes Gold Mine, near Ishpeming. The mine produced gold and silver from 1883 to 1897. If results of investigations prove favorable, the mine will be dewatered, and further testing and bulk sampling of the deposit will occur.

One obstacle to exploration efforts in the Upper Peninsula was the unavailability of State lands; a moratorium on leasing has been in effect since about 1976. Since then, mining firms searching for minerals have requested leases on approximately 390,000 acres of State-owned land, most of which is located in Baraga, Dickinson, Iron, Marquette, and Menominee Counties.

In 1976, the Department of Natural Resources (DNR) appointed a task force to review the State's metallic leasing program and develop environmental and reclamation provisions for a lease. A sample lease form was prepared, and public hearings are expected to be held in 1980. Final approval of the form rests with the Michigan Natural Resources Commission.

During the 1978 to 1979 period, two underground iron mines were closed in the Upper Peninsula, reducing the number of producing mines to four. Inland Steel Co.'s Sherwood Mine in Iron County, the last operating mine on the Menominee Range, was closed in 1978. The mine produced direct-shipping ore of high-phosphorus (0.35%) content, which was incompatible with modern steelmaking techniques. Cleveland-Cliffs closed its Mather B Mine in 1979. The operation, located on the Marquette Range in Marquette County, reached the end of its economic life.

Legislation and Government Programs.—During the 1978 to 1979 biennium, Michigan legislators passed Public Act 203, which protects and regulates use of wetland areas; and Public Act 204, which provides for a resource and land use inventory in the State. The inventory will include information on mineral deposits to assist local government in land use planning.

Michigan industries continued to receive property tax abatements under the Plant Rehabilitation and Industrial Districts Act (Public Act 198, 1974). North Star Steel Co., Willbee Concrete Products Co., Dundee Cement Co., Medusa Cement Co., and Hayes-Albion Corp. were some of the firms receiving tax reductions during 1978 and 1979.

In 1978, DNR completed the first phase of designating sand dune areas to be regulated by the State as required by Michigan's Sand Dune Protection and Management Act (Public Act 222, 1976). Sand dunes are the source of most of the industrial sand produced in the State. Seven areas, which included most active sand dune mining sites, were selected, and procedures were developed to permit and monitor new and active mining operations. DNR contracted with Michigan State University to perform airborne surveillance of sand dune mining areas twice annually. Low-altitude imagery is used to determine mining advances, reclamation progress, and mining violations.

Under Public Act 222, DNR was also required to perform several other studies relating to sand dune mining. Those completed during 1978 and 1979 were as follows: (1) An Economic Study of Coastal Sand Dune Mining in Michigan, (2) Geologic Study of Sand Deposits in the State of Michigan (Phase I), (3) Dune Type Inventory and Barrier Dune Classification Study of the Lake Michigan Shore, (4) Criteria and Methodology for Assessing the Environmental-Aesthetic-Social Impacts of Sand Mining on Barrier Dunes in Michigan, and (5) An Economic and Environmental Assessment of Offshore Sand Mining.

In late 1978, Michigan Technological University at Houghton was designated as a State Mining and Mineral Resources and Research Institute by the Secretary of the Interior. Michigan Tech. is 1 of 31 schools and universities that will establish training programs in mining and minerals extraction. Annual allotments were provided to each school through fiscal year 1984. Each institute initially received a basic grant of $110,000 and $160,000 for scholarships and fellowships.

The Institute of Mineral Research (IMR) at Michigan Tech. completed an underground mine mapping program in western Iron County, sponsored by DNR. The program identified areas of subsidence and determined that the Dobler-Hiawatha complex of mines was the primary source of acid drainage entering the Iron River. In another study, the Institute mapped the abandoned workings and completed a volumetric survey of rock removed from the Hancock Mine, in the city of Hancock. Local government officials will use the information in seeking solutions to their subsidence problems. IMR also continued ground water measurements to monitor possible subsidence at the Sherwood Mine. Projections indicated that the underground mine, closed in 1978, will be entirely filled with water by mid-1981.

During the 1978 to 1979 period, the Geological Survey Division of DNR published several reports on mineral resources. Inland and coastal sand resources, as well as limestone resources, were assessed. The Survey continued ongoing programs to evaluate the quantity, quality, and distribution of mineral resources in the State.

In August 1978, the Michigan Coastal Management Program received Federal approval, and the State was awarded approximately $1.6 million to begin program activities. During program development, funding was provided for economic and environmental assessments of offshore sand mining. Results were incorporated into Michigan's sand dune management program.

The Federal Bureau of Mines and the U.S. Geological Survey conducted mineral surveys of lands under consideration for wilderness designation. Results of two mineral surveys were open filed by the Geological Survey in 1978: (1) Mineral Resources of the Sturgeon River Wilderness Area, Houghton and Baraga Counties, Michigan (OF 78-141), and (2) Mineral Resources of the Rock River Canyon Wilderness Study Area, Alger County, Michigan (OF 78-527).

In 1977, the Forest Service of the U.S. Department of Agriculture initiated its Roadless Area Review and Evaluation (RARE II) program. The program identified roadless and undeveloped land areas in the National Forest System suitable for wilderness use. In 1979, the Forest Service recommended the following to Congress for wilderness use: One area (2,914 acres) in Manistee National Forest, two areas (35,095 acres) in Ottawa National Forest, and four areas (16,162 acres) in Hiawatha National Forest. Congressional action on these areas is expected in the near future.

The Bureau of Land Management initiated a program to develop maps of the surface and mineral estate on lands owned by the Federal Government. The first maps on Michigan areas will be released in mid-1980.

Federal Bureau of Mines contracts and grants to State universities and private industry in Michigan totaled approximately $1.1 million in fiscal years 1978 and 1979. The projects involved mineral availability and mining technology. Michigan State University, under contract with the Federal Bureau of Mines, completed a report in 1978 on the copper resources of northern Michigan. The report estimated reserves at 9.7 million tons from data categorized as reliable and conservative, speculative, and highly speculative. The amount of this reserve that could be mined would depend on market conditions and the types of extraction methods employed.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives, Manufactured.—Two companies reported production of metallic abrasives in 1978 and 1979. Ervin Industries, Inc., in Lenawee County, manufactured steel shot and grit, and Abrasive Materials, Inc., in Hillsdale County, made cut wire shot.

Bromine.—Michigan was one of two States that produced bromine in 1978 and 1979. Bromine was recovered from well brines by three companies and processed at four plants in 1978. One company, Velsicol Chemical Co., was closed for pollution violations in September 1978. Dow Chemical Co.'s plants, in Mason and Midland Counties, and Morton Chemical Co.'s plant, in Manistee County, continued production in 1979.

Calcium Chloride.—Michigan was the Nation's leading producer of natural calcium chloride in 1978 and 1979. During this period, Dow Chemical Co., in Midland and Mason Counties, Wilkinson Chemical Corp., in Lapeer County, and Velsicol Chemical Corp., in Gratiot County, reported production. Velsicol, unable to comply with air pollution standards, ceased operations in 1978.

Cement.—Michigan ranked fourth in cement shipments in the United States in 1978 and 1979. Of the State's seven cement plants, four were located at or near their quarries, two received raw materials from pits and quarries located elsewhere, and one purchased clinker for processing at its facility. Finished portland cement was marketed to ready-mix companies, highway contractors, and concrete product manufacturers.

Medusa Cement Co. continued work on a $50 million modernization program at its Charlevoix plant. Construction is scheduled for completion in the spring of 1980. Modernization includes converting the existing kiln from a wet process to a dry one and installing new dust collection equipment. Cement from the Charlevoix plant was shipped by Medusa Cement's subsidiary, Cement Transit Co., to Milwaukee in bulk form. In 1978, the firm purchased the vessel Steelton from Bethlehem Steel Corp. and was considering plans to convert it to a self-unloading, multicommodity carrier with the capability of handling bulk cement.

In 1978, St. Mary's Cement Co. of Ontario, Canada, acquired Wyandotte Cement, Inc., Michigan's oldest operating cement manufacturing plant, in Wayne County. The company ground clinker shipped from its Bowmanville plant, located about 40 miles east of Toronto. Canada continued as a leading source of clinker for Michigan's cement-processing plants.

Table 4.—Michigan: Portland cement salient statistics

(Short tons)

	1978	1979
Number of active plants	7	7
Production	5,925,754	5,775,667
Shipments from mills:		
Quantity	5,916,530	5,682,500
Value	$211,785,862	$252,057,568
Stocks at mills, Dec. 31	379,799	411,790

Table 5.—Michigan: Masonry cement salient statistics

(Short tons)

	1978	1979
Number of active plants	5	5
Production	284,255	277,708
Shipments from mills:		
Quantity	293,832	261,609
Value	$13,621,368	$16,455,056
Stocks at mills, Dec. 31	62,255	77,181

Clays.—Clay production in Michigan, throughout the 1970's, averaged 2.2 million short tons annually. In 1978 and 1979, eight companies, each operating one mine, produced clay. Primary use was in the manufacture of cement; secondary uses included drain tile, sewer pipe, flue linings, bricks, and flower pots.

In 1978, Michigan Brick, Inc., completed an expansion program that increased production capacity by 50%. An automated brick-manufacturing plant and a specialty brick product plant were constructed. Brick from the complex, located in Shiawassee County, was marketed in Michigan, Ohio, Indiana, Illinois, and southern Ontario.

Gypsum.—Michigan ranked first in the Nation in production of crude gypsum during 1978 and 1979, surpassing for the first time 2 million short tons in 1978. Crude gypsum was produced by National Gypsum Co., United States Gypsum Co., and Michigan Gypsum Co., all in Iosco County, and by Georgia-Pacific Corp. and Grand Rapids Gypsum Co., both in Kent County. Gypsum was used in the manufacture of plaster wallboard, in portland cement, and for soil treatment.

Michigan also ranked among the national leaders in calcined gypsum. Production was reported by four companies in Iosco, Kent, and Wayne Counties. U.S. Gypsum exports some of its crude production to its plant in Lake County, Ind., for calcining.

Iodine.—Of the two States producing iodine, Michigan accounted for about 22% of the Nation's output in both 1978 and 1979. Dow Chemical Co. in Midland County, the State's sole producer, recovered iodine as a byproduct in its brine operations. End product uses included catalysts, inks, pharmaceuticals, stabilizers, and food products.

Lime.—In 1978 and 1979, lime was produced by six companies at nine plants. Quantity and value of production are shown in table 1. Lime was used in alkalies, food products, water purification, steel manufacturing, and sugar refining.

Magnesium Compounds.—Michigan produced 66% and 64% of the Nation's magnesium compounds in 1978 and 1979, respectively. Four companies that produced compounds in 1978 were The Dow Chemical Co., Martin Marietta Chemicals, Morton Chemical Co., and Velsicol Chemical Corp., which closed in 1978.

Martin Marietta Chemicals initiated a $14 million expansion of its Manistee refractories in 1979. The program was instituted to meet demands for refractories and magnesium oxide products. A third multiple-hearth furnace will be added to the plant, and other improvements will be made to increase the capacity for production of light-burn, highly reactive grades of magnesium oxide by 35,000 tons, to 350,000 annually. Completion of the program is scheduled for 1981.

Magnesium oxide was used by the steel industry for lining open-hearth furnaces, and by the rubber industry in the vulcanizing process. It was also used as a fertilizer, a feed ingredient, and in the manufacture of rayon and cellulose acetate.

Peat.—Michigan ranked first among the 22 States producing peat, contributing 29% and 32% of the domestic output in 1978 and 1979, respectively. Peat was processed at 16 plants in 11 counties. Anderson Peat Co. in Lapeer County was the largest producer in 1978 and 1979. The company produced reed sedge peat used for general soil development, in potting soils, and for mushroom beds. Other leading producers in 1979 were Michigan Peat, Inc., in Sanilac County, and Al-Par Peat Co., in Shiawassee County.

Perlite.—Perlite imported from other States was expanded by Harborlite Corp., in Kalamazoo County, and U.S. Gypsum Co., in Wayne County. Expanded perlite was used by breweries and water companies as a filter aid. Perlite's incombustibility and low-water absorption characteristics also make it a suitable insulating material.

Salt.—Among the 17 States producing salt in 1978 and 1979, Michigan ranked fifth. Eight companies in six counties produced 9.7% of the Nation's salt during the biennium. Production was from rock salt and brines. International Salt Co., Inc., was the State's only producer of rock salt, extracting it from an underground mine in Wayne County. The State's seven other operators extracted salt by solution mining. An important use of salt in Michigan was for ice and snow control.

Sand and Gravel.—Throughout the 1970's, sand and gravel production contributed an average of $81 million per year to the State's nonfuel mineral economy. Average annual tonnage during the decade was about 53 million short tons. During 1978 and 1979, Michigan was the Nation's fourth largest producer of sand and gravel; in 1979, the State was the leading producer of industrial sand and gravel, having ranked second in 1978.

Table 6.—Michigan: Construction sand and gravel sold or used, by major use category

Use	1977 Quantity (thousand short tons)	1977 Value (thousands)	1977 Value per ton	1978 Quantity (thousand short tons)	1978 Value (thousands)	1978 Value per ton	1979 Quantity (thousand short tons)	1979 Value (thousands)	1979 Value per ton
Concrete aggregate	12,979	$26,847	$2.07	13,777	$28,857	$2.09	14,019	$32,464	$2.32
Plaster and gunite sands	NA	NA	NA	263	650	2.47	273	658	2.41
Concrete products	2,808	6,386	2.27	2,053	4,356	2.12	1,885	4,210	2.23
Asphaltic concrete	5,670	9,306	1.64	5,329	9,115	1.71	6,572	11,964	1.82
Roadbase and coverings	13,482	23,520	1.74	14,482	26,157	1.81	15,380	28,366	1.84
Fill	4,785	5,427	1.13	5,549	6,954	1.25	4,983	6,048	1.21
Snow and ice control	NA	NA	NA	636	1,175	1.85	629	846	1.34
Railroad ballast	35	110	3.15	36	189	5.21	40	88	2.21
Other uses	615	1,000	1.63	709	1,482	2.09	806	1,992	2.47
Total[1] or average	40,374	72,595	1.80	42,830	78,940	1.84	44,596	86,635	1.94

NA Not available.
[1] Data may not add to totals shown because of independent rounding.

Table 7.—Michigan: Sand and gravel sold or used by producers, by use

Use	1977 Quantity (thousand short tons)	1977 Value (thousands)	1977 Value per ton	1978 Quantity (thousand short tons)	1978 Value (thousands)	1978 Value per ton	1979 Quantity (thousand short tons)	1979 Value (thousands)	1979 Value per ton
Construction:									
Sand	15,495	$24,284	$1.57	18,563	$30,549	$1.65	17,901	$30,016	$1.68
Gravel	24,879	48,311	1.94	24,271	48,390	1.99	26,696	56,619	2.12
Total[1] or average	40,374	72,595	1.80	42,830	78,940	1.84	44,596	86,635	1.94
Industrial:									
Sand	6,102	28,911	4.74	5,428	28,640	5.28	5,572	29,962	5.38
Gravel	11	36	3.27	--	--	--	--	--	--
Total	6,113	28,947	4.74	5,428	28,640	5.28	5,572	29.962	5.38
Grand total[1] or average	46,486	101,542	2.18	48,260	107,600	2.23	50,169	116,597	2.32

[1] Data may not add to totals shown because of independent rounding.

Table 8.—Michigan: Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1977 Quantity	1977 Value	1978 Quantity	1978 Value	1979 Quantity	1979 Value
Alcona	41	46	15	30	84	138
Alger	22	50	14	29	14	29
Allegan	488	951	850	1,518	1,178	2,162
Alpena	100	100	207	385	W	W
Antrim	92	173	W	171	W	127
Arenac	56	92	59	124	36	37
Baraga	163	271	61	92	93	149
Barry	445	903	177	297	127	222
Bay	W	W	W	W	W	W
Benzie	36	45	51	100	51	51
Berrien	1,290	7,050	1,212	6,716	529	2,902

See footnotes at end of table.

Table 8.—Michigan: Sand and gravel sold or used by producers, by county —Continued

(Thousand short tons and thousand dollars)

County	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Branch	W	W	190	W	265	515
Calhoun	435	959	243	712	517	1,512
Cass	606	1,082	584	971	529	783
Charlevoix	170	277	236	438	322	647
Cheboygan	W	W	W	W	105	184
Chippewa	572	989	471	735	389	632
Clare	290	436	347	596	329	567
Clinton	1,128	1,867	2,036	3,667	1,132	2,518
Crawford	49	73	--	--	--	--
Delta	323	597	275	524	166	385
Dickinson	212	499	238	480	327	793
Eaton	548	891	467	778	496	1,065
Emmet	171	282	123	207	W	W
Genesee	W	W	225	414	W	W
Gladwin	10	15	10	15	W	W
Gogebic	166	242	251	444	134	202
Grand Traverse	177	258	80	110	43	97
Gratiot	446	640	419	624	250	459
Hillsdale	462	882	637	1,110	881	1,594
Houghton	214	337	255	461	560	833
Huron	73	122	139	241	126	217
Ingham	891	1,267	275	413	619	1,063
Ionia	131	195	126	194	100	122
Iosco	3	5	1	2	104	104
Iron	244	439	330	495	277	412
Isabella	605	1,018	W	W	W	W
Jackson	324	576	324	580	515	1,036
Kalamazoo	809	2,169	961	1,889	941	1,940
Kalkaska	6	6	--	--	27	27
Kent	2,241	4,259	2,364	5,244	3,246	7,219
Lake	44	75	74	144	77	144
Lapeer	573	1,039	547	976	397	621
Leelanau	149	W	W	W	W	W
Lenawee	634	1,149	476	864	441	900
Livingston	1,872	3,113	1,757	2,859	2,014	3,592
Luce	45	120	14	28	14	28
Mackinac	159	270	161	284	149	245
Macomb	1,270	2,499	1,282	2,973	1,966	7,313
Manistee	154	217	92	128	86	116
Marquette	865	1,682	899	1,928	597	1,212
Mason	W	W	53	54	755	W
Mecosta	327	492	352	565	334	609
Menominee	84	118	89	135	442	502
Missaukee	180	248	W	W	W	W
Montcalm	361	1,004	187	509	W	W
Muskegon	691	3,211	900	4,477	802	4,330
Newaygo	W	W	23	W	23	W
Oakland	10,643	20,169	11,659	22,762	12,288	25,623
Oceana	522	2,808	484	2,361	803	3,429
Ogemaw	265	380	409	640	359	736
Ontonagon	187	225	133	199	62	94
Osceola	313	580	235	430	253	483
Otsego	25	38	104	155	110	204
Ottawa	1,871	5,138	2,082	3,844	2,578	5,643
Presque Isle	566	1,340	W	W	W	W
Saginaw	797	2,328	1,695	6,236	626	2,105
St. Clair	W	W	1,161	1,939	262	906
St. Joseph	429	825	429	673	460	764
Sanilac	385	577	383	518	377	653
Schoolcraft	58	81	84	174	W	W
Shiawassee	357	525	370	531	199	225
Tuscola	705	1,527	808	1,807	764	1,339
Van Buren	W	W	192	332	230	297
Washtenaw	2,057	3,319	2,251	3,207	2,447	3,531
Wayne	1,161	5,470	1,122	6,666	1,456	7,879
Wexford	608	1,660	641	1,875	844	1,979
Undistributed[1]	4,089	9,301	2,860	6,548	3,443	10,351
Total[2]	46,486	101,542	48,262	107,574	50,169	116,597

W Withheld to avoid individual company proprietary data; included in "Undistributed."

[1] Includes sand and gravel that cannot be assigned to specific counties and data indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Construction sand and gravel was produced in 75 of the State's 83 counties. Leading counties in production were Oakland, Kent, Ottawa, Washtenaw, and Livingston in 1979. Of the 332 sand and gravel operations throughout Michigan, 282 produced less than 300,000 tons, 31 produced between 300,000 and 500,000 tons, and 19 produced between 500,000 and 2 million tons. The latter 19 operations accounted for 35% of the State's total production.

Construction sand and gravel comprised the bulk of the material produced and was mainly for concrete aggregate and as road base. Other uses included fill, asphalt aggregate, and concrete products.

Industrial sand was mined by 11 companies from 15 deposits. Most industrial sand is produced from sand dunes along Lake Michigan's eastern shore. Leading producers were Sargent Sand Co., Saginaw County; Manley Bros. of Indiana, Inc., Berrien County; Nugent Sand Co., Inc., Muskegon County; and Ottawa Silica Co., Wayne County. Industrial sand was used for foundry moldings and core, glass containers, and flat glass.

Sand dune mining in Michigan was monitored under the Sand Dune Protection and Management Act. In 1978, 15 permit applications were submitted by 10 operators in 6 counties. Of the 15 permits sought, 6 were approved by the end of 1979, 7 were in review status, and 2 were denied and pending administrative appeals.

Slag—Iron and Steel.—Michigan continued as one of the Nation's leading slag producers, ranking fourth in 1978 and 1979. Slag, a byproduct of steelmaking, was used mainly by the construction industry. Edward C. Levy Co., in Wayne County, processed slag from Ford Motor Co.'s Steel Division, Great Lakes Steel, and McLouth Steel Corp.

Sodium Compounds.—BASF Wyandotte Corp. terminated production of synthetic soda ash at its Wyandotte plant in late 1978. The company stated that competition from western natural soda ash (trona) suppliers and costly pollution control requirements forced the closure.

Stone.—During the 1970's, stone production averaged about 42 million short tons per year. Production and value during the 1977 to 1979 period are shown in table 1. In 1978, stone was extracted in 21 counties at 41 quarries. Nine quarries each produced in excess of 900,000 tons of stone and altogether accounted for 86% of the State total. Leading counties, in decreasing order of tonnage, were Presque Isle, Mackinac, Monroe, Alpena, and Chippewa.

Table 9.—Michigan: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	430	923	512	1,164	366	956
Agricultural marl and other soil conditioners	22	67	26	59	23	50
Concrete aggregate (coarse)	r4,400	r8,127	4,732	9,336	4,761	9,882
Bituminous aggregate	1,231	2,480	1,897	4,799	2,151	5,972
Macadam aggregate	W	W	W	W	603	1,307
Dense-graded roadbase stone	1,126	2,547	946	2,205	1,277	3,526
Surface treatment aggregate	125	304	120	311	138	428
Other construction aggregate and roadstone	2,540	r5,273	2,113	5,386	4,089	11,159
Riprap and jetty stone	r371	722	174	363	588	1,607
Railroad ballast	266	533	292	651	437	1,075
Manufactured fine aggregate (stone sand)	44	121	81	184	W	W
Terrazzo and exposed aggregate	W	W	(2)	10	W	4
Cement manufacture	8,314	r15,162	6,997	12,851	7,234	15,159
Lime manufacture	r8,906	r18,214	9,389	21,543	9,810	25,027
Flux stone	r9,423	r21,488	10,660	27,497	7,468	21,489
Other uses[3]	r3,320	r9,011	2,190	4,623	862	2,191
Total[4]	r40,517	r84,971	40,129	90,981	39,909	99,832

r Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite (1979), marl, sandstone (1977 and 1979), and traprock.

[2] Less than 1/2 unit.

[3] Includes stone used for poultry grit and mineral food, filter stone (1977-78), dead-burned dolomite (1977-78), refractory stone (1977-78), chemical stone, glass manufacture (1977-78), paper manufacture, sugar refining, waste material (1979), and data indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

Crushed stone accounted for about 98% of the total stone produced. Limestone was the major rock type mined, followed by sandstone, marl, and traprock. Dimension limestone and sandstone were extracted at five quarries in Eaton, Jackson, Presque Isle, and Schoolcraft Counties.

Stone was transported by waterway, truck, and rail. Michigan limestone producers shipped stone by lake freighter to Indiana lime manufacturers.

Sulfur.—Three oil refineries recovered sulfur as a byproduct. Total Petroleum Ltd., in Gratiot County, and Marathon Oil Corp., in Wayne County, produced sulfur in 1978 and 1979. Shell Oil Co. in Manistee County began separation of sulfur from natural gas in 1979; production was expected to reach 25 tons per day when the plant is fully operational.

In 1979, the State Transportation Department tested 220 short tons of sulfur on a road-paving project. Sulfur was substituted for up to 50% of the asphalt in the paving because it tends to be more resistant to pavement cracks caused by freezing conditions and heavy traffic.

Vermiculite.—W. R. Grace & Co. processed vermiculite mined out of State at its plant in Wayne County, in 1978 and 1979. Exfoliated vermiculite was used mainly in the manufacture of loosefill and block insulation. Other uses included concrete aggregate, plaster aggregate, horticultural applications, soil conditioning, and fireproofing.

METALS

Copper.—In 1978 and 1979, Copper Range Co., Michigan's only producer, operated an underground mine and mill-smelter complex at White Pine, Ontonagon County. The extracted material—which occurs primarily as chalcocite (Cu_2S) in shales, siltstones, and sandstone—was crushed, ground, and concentrated. The concentrate was fire refined and smelted to the configurations in demand by consumers.

The Copper Range Co. was purchased by the Louisiana Land and Exploration Company (LL&E) in May 1977. A major cost reduction program and increased prices for refined copper resulted in profitable operations in the fourth quarter of 1978 and again in 1979.

Iron Ore.—Michigan was the Nation's second leading iron ore producer in 1978 and 1979, providing approximately one-fifth of the U.S. output for both years. During the first half of 1978, six iron ore mines were operating in the State. The Tilden, Empire, and Republic Mines in Marquette County (Cleveland-Cliffs Iron Co.) and the Groveland Mine in Dickinson County (Hanna Mining Co.) were operated as large open pits. The Sherwood Mine (Inland Steel Co.) and the Mather B Mine (Cleveland-Cliffs) were worked underground.

The closure of the Sherwood Mine in 1978 and the Mather B Mine in 1979 reduced the number of operators to two and the number of mines to four by yearend. The Sherwood Mine in Iron County, in operation since 1943, was closed because the high-phosphorus (0.35%) direct-shipping ore was incompatible with modern steelmaking techniques. Shipments of the Sherwood ore continued from stockpile through 1979.

Table 10.—Michigan: Usable iron ore[1] produced (direct shipping and all forms of concentrates), by range

(Thousand long tons)

Year	Marquette range	Menominee range (Michigan part)	Gogebic range (Michigan part)	Total		
				Gross weight		
				Ore[2]	Iron content	Iron content (percent)
1854-1974	426,679	302,706	249,625	979,011	NA	NA
1975	12,443	2,331	--	14,774	9,327	63.1
1976	14,663	2,318	--	16,980	10,759	63.4
1977	9,799	2,520	--	12,319	7,798	63.3
1978	W	W	--	16,752	10,652	63.6
1979	W	W	--	17,132	10,933	63.8
Total[2]	493,156	[3]314,187	[3]249,625	1,056,968	NA	NA

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Exclusive after 1905 of iron ore containing 5% or more manganese.

[2] Data may not add to totals shown because of independent rounding.

[3] Distribution by range partly estimated before 1906.

Table 11.—Michigan: Iron ore shipped from mines

(Thousand long tons)

Year	Direct-shipping ore[1]	Concentrates and agglomerates, total	Total usable ore[2]	Proportion of beneficiated ore to total usable ore (percent)
1975	289	13,801	[2]14,089	98.0
1976	356	15,888	[2]16,245	97.8
1977	W	W	12,009	W
1978	W	W	17,538	W
1979	W	W	17,196	W

W Withheld to avoid disclosing company proprietary data.

[1] Includes crushed, screened, and sized ore not further treated.

[2] Data may not add to totals shown because of independent rounding.

The Mather Mine, near Negaunee in Marquette County, was closed, having reached the end of its economic life. This also necessitated closure of the ore improvement plant and the Pioneer pellet plant at Eagle Mills. Development of the Mather Mine began in 1941. It was the last operating underground iron mine in Michigan.

Cleveland-Cliffs completed a $364 million expansion in 1979, which doubled production at the Tilden pellet plant in Palmer to 8 million long tons per year. An expansion program at the Empire Mine, scheduled for completion in 1980, is expected to increase annual capacity from 5.2 million to 8 million tons. The Empire Mine and pellet plant began operations in 1963, producing 1.6 million tons of iron ore pellets. By mid-1978, a total of 50 million tons had been produced at the facility. The plant utilizes a fully autogenous grinding process, as well as a flotation extracting technique, to convert low-grade magnetite-iron (35%) into high-grade pellets (64%).

Iron Oxide Pigments.—Michigan ranked first in production of natural iron oxide pigments, contributing 58% and 64% of the national total in 1978 and 1979, respectively. Natural iron oxide pigments were produced in Marquette County by Cleveland-Cliffs Iron Co., the State's only producer. The primary use of these pigments was in the manufacture of paint. BASF Wyandotte Corp. produced synthetic finished iron oxide pigments in Wayne County.

Iron and Steel Scrap.—North Star Steel Co. of Minnesota announced plans for a $70 million steel mill in Monroe. Construction began in 1978 and was scheduled for completion in early 1980. The mill will use electric furnaces to recycle scrap metal into steel products for use in the automotive and related industries. Initial plant capacity will be 400,000 tons per year, gradually increasing to 1 million. The mill's principal market area will be Michigan and Ohio.

Pig Iron and Steel.—Michigan ranked fourth in the Nation in pig iron and steel production in 1978 and 1979. A major portion of the steel was used in the manufacture of transport equipment, primarily automobiles, trucks, and related products. About 2,000 pounds of steel and 600 pounds of cast iron are utilized in the manufacture of the average automobile in the United States.

The Institute for Iron and Steel Studies reported in 1978 that Michigan's total raw steel capacity was over 13 million tons. Only 15 countries of the world have more raw steel capacity than plants located in the Detroit area.

Ford Motor Co., McLouth Steel Corp., and National Steel Co. are completely integrated, with a total annual production capacity of about 12 million tons. Ford's integrated industrial complex at River Rouge converted raw iron ore to iron and steel products used at an automobile assembly plant. In 1979, Ford was the only U.S. automobile company with its own steelmaking facilities.

National Steel Co.'s Great Lakes Steel Division at Ecorse placed a new steel slab caster in operation in 1978. Under normal conditions, production will be 1.5 million tons of slabs per year.

McLouth Steel Corp.'s steelmaking facilities, located in southeast Michigan, manufactured carbon and stainless steel flat-rolled products. The company processed iron ore pellets and scrap and metal alloys. Flat-rolled products were marketed principally to the automotive industry.

Silver.—White Pine Copper Div. of Copper Range Co. continued to recover byproduct silver from copper ore mined in Ontonagon County.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

[2] Physical scientist, Bureau of Mines, Pittsburgh, Pa.

Table 12.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:[1]			
Cement Div., National Gypsum Co.	17515 West 9 Mile Rd. Southfield, MI 48075	Quarry and plant	Alpena.
Dundee Cement Co.	Box 122 Dundee, MI 48131	do	Monroe.
Medusa Cement Co., Div. of Medusa Corp.	Box 5668 Cleveland, OH 44101	do	Charlevoix.
Peerless Cement Co., a division of Amcord Inc.	9333 Dearborn St. Detroit, MI 48209	do	Wayne.
Penn-Dixie Industries Inc.	Box 152 Nazareth, PA 18064	do	Emmet.
Clay and shale:			
Michigan Brick Inc	3820 Serr Rd. Corunna, MI 48817	Pit and plant	Shiawassee.
Copper:			
White Pine Copper Div.[2] of Copper Range Co.	Box 427 White Pine, MI 49971	Underground mine and plant.	Ontonagon.
Gypsum:			
Michigan Gypsum Co	2840 Bay Rd. Saginaw, MI 48605	Open pit mine and plant.	Iosco.
National Gypsum Co.	4100 First International Bldg. Dallas, TX 75270	do	Do.
United States Gypsum Co.	101 South Wacker Dr. Chicago, IL 60606	do	Iosco and Wayne.
Iron ore:			
Cleveland-Cliffs Iron Co.[3]	504 Spruce St. Ishpeming, MI 49849	Open pit mines and plants.	Marquette.
Hanna Mining Co	Star Route 1, Box 131 Iron Mountain, MI 49801	Open pit mine and plant.	Dickinson.
Iron and steel:			
Ford Motor Co	The American Rd. Dearborn, MI 48121	Plant	Wayne.
McLouth Steel Corp	300 South Livernois Ave. Detroit, MI 48217	do	Do.
National Steel Corp	2800 Grant Bldg. Pittsburgh, PA 15219	do	Do.
Lime:			
BASF Wyandotte Corp	1609 Biddle Ave. Wyandotte, MI 48192	Limekiln	Do.
Detroit Lime Co., a subsidiary of Edward C. Levy Co.	8800 Dix Ave. Detroit, MI 48209	do	Do.
The Dow Chemical Co., Ludington Div	2020 Dow Center Midland, MI 48640	do	Mason.
Marblehead Lime Co., a division of General Dynamics.	300 West Washington Chicago, IL 60606	do	Wayne.
Natural salines:[4]			
The Dow Chemical Co	2020 Dow Center Midland, MI 48640	Brine wells and plant	Mason and Midland.
Martin Marietta Chemicals, Refractories Div.	Executive Plaza II Hunt Valley, Md 21030	do	Manistee.
Morton Chemical Co	110 North Wacker Dr. Chicago, IL 60606	do	Do.
Peat:			
Al-Par Peat Co	9551 Krouse Ovid, MI 48866	Bog and plant	Shiawassee.
Anderson Peat Co	Box 575 Perry, MI 48872	do	Lapeer and Shiawassee.
Michigan Peat, Inc	Box 66388 Houston, TX 77006	Bogs and plants	Sanilac.
Salt:			
BASF Wyandotte Corp	1609 Biddle Ave. Wyandotte, MI 48192	Brine wells and plant	Wayne.
Diamond Crystal Salt Co	916 South Riverside St. Clair, MI 48079	do	St. Clair.
International Salt Co., Inc	12841 Saunders St. Detroit, MI 48217	Underground mine	Wayne.

See footnotes at end of table.

Table 12.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel:			
Construction:			
American Aggregates Corp	Drawer 160 Greenville, OH 45331	Surface pits and stationary plants.	Kalamazoo, Livingston, Macomb, Oakland.
Grand Rapids Gravel Co	2700 28th St., SW Grand Rapids, MI 49509	do	Kent.
Holly Sand and Gravel Co., Aggregate Div. of J. P. Burroughs & Son, Inc.	Box 1468 Saginaw, MI 48605	Surface pit, stationary and portable plants.	Oakland.
Medusa Materials Co	Box 150 Lafayette, IN 47902	Surface pit and stationary plant.	Do.
Industrial:			
Manley Bros. of Indiana, Inc	Box 67 Chesterton, IN 46304	do	Berrien.
Nugent Sand Co., Inc	Box 566, 2875 Lincoln Muskegon, MI 49443	do	Muskegon.
Ottawa Silica Co., Michigan Silica Div	33620 Streicher Rd. Rockwood, MI 48173	do	Wayne.
Sargent Sand Co	2840 Bay Rd. Saginaw, MI 48605	do	Mason and Tuscola.
Slag:			
Edward C. Levy Co	8800 Dix Ave. Detroit, MI 48209	Plant	Wayne.
Stone:			
Limestone:			
Drummond Dolomite Inc., Div. of Bethlehem Steel Corp.	701 East 3d St. Bethlehem, PA 18016	Quarry and plant	Chippewa.
The France Stone Co.	Box 1928, Toledo Trust Bldg. Toledo, OH 43603	Quarry	Monroe.
Inland Lime and Stone Co., a division of Inland Steel Co.	Gulliver, MI 49840	Quarry and plant	Mackinac and Schoolcraft.
Limestone Operations, United States Steel Corp.	Rogers City, MI 49779	Quarry	Mackinac and Presque Isle.
Presque Isle Corp	Box 426 Alpena, MI 49707	do	Presque Isle.
Marl:			
Kevin D. Brenner	Route 1 Hopkins, MI 49328	Pit	Allegan.
Poehlman & Son	Route 2 Cassopolis, MI 49031	Quarry	Cass.
Sandstone:			
Jude Stone Quarry Co	338 Austin Rd. Napoleon, MI 49261	do	Jackson.
Napoleon Sandstone Quarry	Box 119 Napoleon, MI 49261	do	Do.
Ottawa Silica Co., Michigan Silica Div	33620 Streicher Rd. Rockwood, MI 48173	Quarry and plant	Wayne.

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[1] Also produce clay and shale.
[2] Also produces silver.
[3] Also produces iron oxide pigments.
[4] Includes bromine, bromine compounds, calcium compounds, iodine, and magnesium compounds.

The Mineral Industry of Minnesota

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Mineral Resources Research Center, University of Minnesota, for collecting information on all nonfuel minerals.

By James H. Aase[1] and Wanda J. West[2]

The value of nonfuel mineral production in Minnesota for 1978 and 1979 was $1,725 million and $2,068 million, respectively. The increase in value of the 1978 production over that of the previous year was attributed to a rebound from a 138-day steelworkers' strike in the State's iron ore mining industry in 1977, coupled with rises in the unit values for iron ore and other mineral commodities.

Nationally, Minnesota was first among the States in value of nonfuel mineral production in 1978 and second in 1979. Production in 1978 was reported from approximately 550 operations located in 83 of the State's 87 counties. St. Louis County maintained its lead in terms of mineral quantity and value output. Mineral production valued in excess of $1 million was recorded in 25 counties.

Two metallic and seven nonmetallic mineral commodities were produced in Minnesota during 1978 and 1979. Iron ore ranked first in terms of value, exceeding the second

Table 1.—Nonfuel mineral production in Minnesota[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2] thousand short tons	163	$276	174	$2,090	135	$1,905
Gem stones	NA	15	NA	5	NA	5
Iron ore (usable) thousand long tons, gross weight	30,245	782,627	56,473	1,627,099	59,682	1,965,710
Lime thousand short tons	123	4,315	116	4,263	140	5,133
Manganiferous ore short tons	166,440	W	253,399	W	181,503	W
Peat thousand short tons	28	1,280	20	716	21	827
Sand and gravel do	30,713	59,629	[3]31,080	[3]54,967	[3]30,939	[3]55,427
Stone:						
Crushed do	7,831	16,991	9,666	20,734	9,751	22,175
Dimension do	33	8,133	35	9,356	38	11,543
Combined value of abrasive stone (1977 and 1979), clays (kaolin), industrial sand (1978-79), and values indicated by symbol W	XX	2,337	XX	5,502	XX	5,265
Total	XX	875,603	XX	1,724,732	XX	2,067,990

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure.

XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes kaolin; value included in "Combined value" figure.

[3] Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Minnesota, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Aitkin	W	$167	Sand and gravel, peat.
Anoka	W	W	Sand and gravel.
Becker	$479	452	Do.
Beltrami	523	248	Do.
Benton	--	W	Do.
Big Stone	2,110	1,851	Stone, sand and gravel.
Blue Earth	1,820	2,551	Do.
Brown	W	W	Sand and gravel, clays.
Carlton	W	W	Sand and gravel, peat.
Carver	W	W	Sand and gravel.
Cass	465	159	Do.
Chippewa	495	455	Do.
Chisago	345	280	Do.
Clay	3,906	2,260	Sand and gravel, lime.
Clearwater	237	100	Sand and gravel.
Cook	216	42	Do.
Cottonwood	230	199	Do.
Crow Wing	W	W	Manganiferous ore, sand and gravel.
Dakota	5,048	W	Sand and gravel, stone.
Dodge	W	616	Stone, sand and gravel.
Douglas	450	651	Sand and gravel.
Faribault	W	W	Do.
Fillmore	1,098	925	Stone, sand and gravel.
Freeborn	965	834	Sand and gravel.
Goodhue	558	627	Stone, sand and gravel.
Grant	5	W	Sand and gravel.
Hennepin	W	8,357	Sand and gravel, clays.
Houston	W	W	Stone, sand and gravel.
Hubbard	340	361	Sand and gravel.
Isanti	--	143	Do.
Itasca	99,468	148,501	Iron ore, sand and gravel, peat.
Kanabec	258	W	Sand and gravel.
Kandiyohi	1,215	913	Do.
Kittson	551	491	Do.
Koochiching	418	331	Do.
Lac qui Parle	364	469	Stone, sand and gravel.
Lake	312	331	Sand and gravel.
Lake of the Woods	78	78	Do.
Le Sueur	W	W	Sand and gravel, stone.
Lincoln	11	11	Sand and gravel.
Lyon	75	75	Do.
McLeod	85	159	Do.
Mahnomen	80	130	Do.
Marshall	260	397	Do.
Martin	8	--	
Meeker	248	278	Sand and gravel.
Mille Lacs	W	W	Stone, sand and gravel.
Morrison	2,098	1,866	Sand and gravel.
Mower	W	1,384	Stone, sand and gravel.
Murray	63	85	Sand and gravel.
Nicollet	W	1,327	Stone, sand and gravel.
Nobles	W	W	Sand and gravel.
Norman	291	382	Do.
Olmsted	2,602	3,208	Stone, sand and gravel.
Otter Tail	411	216	Sand and gravel.
Pennington	205	W	Do.
Pine	W	W	Do.
Polk	2,920	2,907	Lime, sand and gravel.
Pope	131	296	Sand and gravel.
Ramsey	W	W	Do.
Red Lake	5	5	Do.
Redwood	W	W	Sand and gravel, clays, stone.
Renville	W	2,471	Lime, stone, sand and gravel.
Rice	3,201	741	Sand and gravel, stone.
Rock	733	584	Do.
Roseau	5	5	Sand and gravel.
St. Louis	W	1,483,066	Iron ore, sand and gravel, stone, peat.
Scott	2,814	3,304	Stone, sand and gravel.
Sherburne	1,687	2,815	Sand and gravel.
Sibley	82	W	Do.
Stearns	W	W	Stone, sand and gravel.
Steele	W	W	Sand and gravel, stone.
Stevens	W	W	Sand and gravel.
Swift	146	178	Do.
Todd	564	476	Do.
Wabasha	669	963	Sand and gravel, stone.
Wadena	W	161	Sand and gravel.
Waseca	150	150	Do.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Minnesota, by county[1] —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Washington	$7,890	$7,808	Sand and gravel, stone.
Watonwan	142	31	Sand and gravel.
Wilkin	171	344	Do.
Winona	2,149	2,162	Stone, sand and gravel.
Wright	$774	$755	Sand and gravel.
Yellow Medicine	1,104	W	Stone, sand and gravel.
Undistributed[2]	721,880	33,598	
Total[3]	875,603	1,724,732	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] The following counties are not listed because no production was reported: Jackson, Pipestone, and Traverse.

[2] Includes some sand and gravel that cannot be assigned to specific counties, value of gem stones, and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Minnesota business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force ... thousands	1,920.0	2,003.0	2,063.0	+3.0
Unemployment ... do	98.0	76.0	86.0	+13.2
Employment (nonagricultural):				
Mining ... do	12.9	16.4	17.2	+4.9
Manufacturing ... do	339.3	360.4	382.6	+6.2
Contract construction ... do	68.7	79.0	84.2	+6.6
Transportation and public utilities ... do	92.4	93.9	100.3	+6.8
Wholesale and retail trade ... do	403.5	426.9	444.4	+4.1
Finance, insurance, real estate ... do	82.2	86.3	91.8	+6.4
Services ... do	312.0	333.3	355.8	+6.8
Government ... do	286.3	292.8	294.4	+.5
Total nonagricultural employment ... do	1,597.3	[1]1,688.9	1,770.7	+4.8
Personal income:				
Total ... millions	$28,206	$31,680	$35,567	+12.3
Per capita	$7,086	$7,904	$8,760	+10.8
Construction activity:				
Number of private and public residential units authorized	38,337	[2]37,823	29,511	-22.0
Value of nonresidential construction ... millions	$433.4	$679.5	$756.7	+11.4
Value of State road contract awards ... do	$145.0	$175.0	$202.1	+15.5
Shipments of portland and masonry cement to and within the State ... thousand short tons	1,714	1,830	1,772	-3.2
Nonfuel mineral production value:				
Total crude mineral value ... millions	$875.6	$1,724.7	$2,068.0	+19.9
Value per capita, resident population	$220	$430	$509	+18.4
Value per square mile	$10,415	$20,516	$24,599	+19.9

[p] Preliminary.

[1] Data do not add to total shown because of independent rounding.

[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

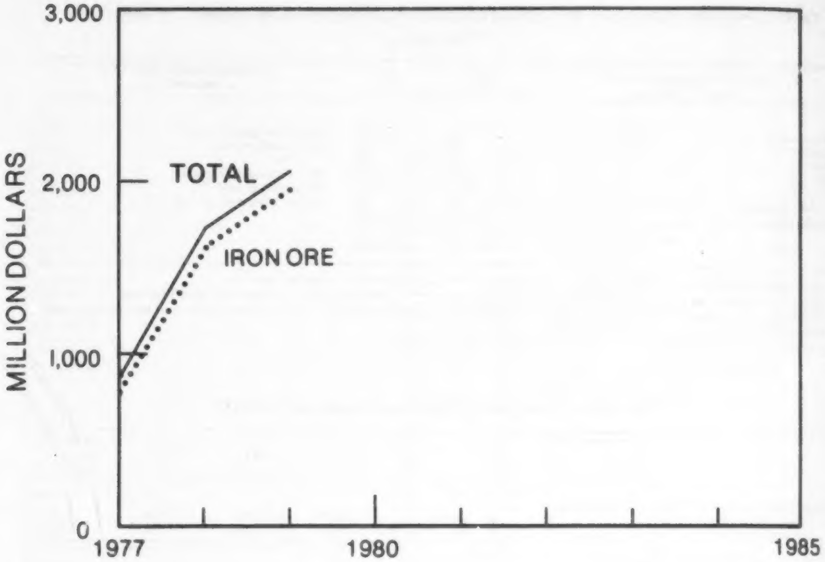

Figure 1.—Value of iron ore shipments and total value of nonfuel mineral production in Minnesota.

ranked commodity, sand and gravel, by approximately thirtyfold.

Annual pellet production capacity of Minnesota's taconite industry increased to 63.9 million gross tons in 1979 with the completion of an expansion project at Hibbing Taconite Co.'s plant on the Mesabi Range.

AMAX Exploration, Inc., completed near yearend 1979 the first phase in its feasibility study for establishing a copper-nickel mine and processing facilities at its Minnamax project site near Babbitt. The first phase of the project included surface and underground core drilling, bulk sampling of mineralized material obtained for metallurgical testing from a test shaft and exploration drifts, and development of a proposed mine plan design. A second phase of the project under consideration by the company is the construction of a 250-ton-per-day pilot plant to further evaluate ore concentrating characteristics and to provide material for smelting and refining studies.

In 1979, the State of Minnesota concluded a 3-year Regional Copper-Nickel Study to examine the environmental, social, and economic impacts that could result from mining copper-nickel ores in northeastern Minnesota. The $4.3 million study covered 2,000 square miles of pristine wilderness. A committee representing concerned State agencies was established near yearend 1979 to review the data and reports compiled in the study and to design a program of follow up activities prior to release for public review. Information contained in the report will be used by State officials to make decisions concerning the development of copper-nickel resources in Minnesota.

A severe cement shortage plagued Minnesota much as it did other North Central States during 1978. The State, which relies exclusively on out-of-State supplies to fill its cement requirements, experienced a cutback of approximately 50% in shipments during the last half of 1978 that caused a marked slowdown of construction projects. Heeding industry projections that indicated continued shortages of cement nationally, the Minnesota Department of Economic Development investigated the feasibility of establishing an in-State cement plant. Seven sites that had adequate raw materials resources and transportation facilities available were identified in the southern part of the State.[3] In an effort to compensate for the cement shortage, the Minnesota Department of Transportation began for the first time in 1978, to allow the use of up to 25% fly ash in concrete mixtures for highway and bridge deck construction.

An effective measure of the economic growth is the Gross State Production (GSP), which is an aggregation of the market value of all goods and services produced for final demand in the ecomomy for the year. According to statistics released by Minnesota Department of Economic Development, the mining and quarrying industries of the State accounted for 2.6% of Minnesota's GSP in 1978 and 1979. The Minnesota GSP in 1978 was $40,874 million, and a preliminary figure of $45,000 million was reported for 1979.

Employment.—Employment in the mining and quarrying industries at yearend 1978 totaled 17,700 workers, nearly 41% more than at the end of the previous year, according to statistics published by the Minnesota Department of Economic Security. The marked increase in 1978 employment was attributed to the return to normalcy in the iron ore industry following the steelworkers' strike in 1977, together with near capacity production coming from new and expanded taconite operations.

Department of Economic Security statistics indicated that peak employment in the mining and quarrying industries during 1979 was reached in August with 18,600 persons employed. By yearend, employment had leveled off to 16,800 workers. Nearly 92% of the work force in December 1979 was employed in the metal-mining industry, with average hourly earnings of $10.43, a rate 12% higher than at the end of the previous year.

Legislation.—The Minnesota Legislature enacted into law a number of measures of interest to the State's mineral industry during 1978 and 1979. Included were acts to (1) require companies or persons producing minerals, except sand and gravel and crushed stone, to erect fencing around mine excavations that have been idle 6 months or longer, (2) repeal right of eminent domain of taconite and semitaconite companies for easements, surface rights, flowage rights, water, wharves, piers, etc., and (3) authorize counties to levy an occupation tax on the business of removing gravel from pits within those counties, limiting the tax to a maximum of 10 cents per cubic yard.

In 1979, the Minnesota Supreme Court upheld the constitutionality of a 1973 State Mineral Registration Act that allows the State to tax severed mineral interests at a rate of 25 cents per acre per year. The law had been challenged in the courts by various mining and private interests almost continuously since its enactment.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Iron Ore.—Minnesota continued as the Nation's leading iron-ore—producing State, supplying more than two-thirds of the total usable iron ore shipped from all mines in the United States during 1978 and 1979.

The value of shipments of usable iron ore from Minnesota mines reached an alltime high in the biennium 1978-79. This achievement reflected resumption of mining operations after a 4-month strike in the iron ore industry during the latter part of 1977, increased production from expanded facilities, and a higher unit value received for the ore.

The State's iron ore production during the biennium was from mines located on the Mesabi Range in Itasca and St. Louis Counties. Production was from 32 open pit mines or mine groups operated by 11 companies in 1978 and from 21 mines operated by 10 companies in 1979.

The major role played by the expanding taconite industry was evidenced in the biennium when eight taconite operations contributed more than 90% of the State's usable iron ore output, the remainder coming from beneficiated natural ore. The increased percentage of taconite output raised the average iron content of the total State production to a new high of 62.75% in 1979.

The State's iron ore industry invested about $1.5 billion to construct two new taconite facilities and to expand two others during a 6-year construction period ending in 1979.

In October 1978, United States Steel Corp. began pellet production from the Step III expansion at its Minntac plant near Mountain Iron that raised the plant's pellet production capacity to more than 18 million tons annually. The Step III expansion added 6 grinding lines to the concentrator, bringing the total number of lines under one roof to 18. The agglomerator in the Step III expansion has the unique capability to burn pulverized coal in its two pelletizing lines, unlike those installed in earlier construction. In November 1978, a landmark was reached at Minntac when the plant shipped its 100-millionth gross ton of pellets after approximately 11 years operation.

Hibbing Taconite Co.'s expansion project, which was completed in 1979, brought the plant's pellet production capacity to 8.1 million tons annually. During 1978, Republic Steel Corp. acquired an ownership interest in the Hibbing Taconite Co. operation, entitling it to 1.3 million tons of the annual production capacity. Other participants in the operation included Bethlehem Steel Corp., Steel Company of Canada, Ltd., and Pickands Mather & Co., the managing agent.

In April 1978, the Minnesota Pollution Control Agency (PCA) granted approval for the last of the permits required from the State for operation of Reserve Mining Co.'s onland taconite tailings disposal site at Milepost 7, west of Silver Bay. This would allow Reserve to comply with a Federal court order to switch to onland disposal of tailings from its present practice of dumping tailings into Lake Superior by April 15, 1980. Reserve's $370 million project to construct the new disposal facilities, upgrade the concentrator, and install pollution control equipment at its Silver Bay plant was 80% completed at yearend 1979.

Based on a 1978 recommendation by the PCA, the Mesabi Range and an area around Silver Bay were identified by the Environmental Protection Agency as nonattainment areas for ozone and particulates under the terms of the 1977 Federal Clean Air Act. The designation was challenged by most of the iron ore producers as a deterrent to the future expansion of mining and processing activities. Petitions filed with the U.S. Eighth Circuit Court of Appeals for review of the ruling and documented appeals directed to PCA, indicating company compliance with standards, brought some relief. The PCA Board deleted from the noncompliance status 144 square miles of the Mesabi Range on the eastern end and 500 square miles on the western end, but the remainder of the range continued to be designated a nonattainment area. The State has contracted with a private firm to analyze dust emissions resulting from mining with the intention that results of the study be used for future regulation of the industry and to identify those means that can be utilized to reduce dust emissions.

The Duluth Missabe & Iron Range Railway dedicated new taconite storage and shiploading facilities at Two Harbors in September 1978. Built at a cost of $35.5 million, the facilities increased the shiploading capacity of the port to 20 million tons of taconite pellets annually and provided a 40-acre iron pellet storage-reclaim area with an initial capacity of 2 million gross tons. Retractable shuttle belt conveyors built into the No. 2 dock enable supercarriers to be loaded at a rate of 10,000 tons per hour.

Published prices for Lake Superior iron ore increased during the biennium. Prices in effect as of December 31, 1979, were as follows: Mesabi nonbessemer, $24.60 per ton; Old Range nonbessemer, $24.85 per ton; and manganiferous, $24.85 per ton; all for ore delivered at rail-of-vessel at lower Lake ports and based on a natural iron content of 51.50%. The Lower Lake price for pellets was 67.8 cents per long ton iron unit. These prices reflect an 11% increase in the price of pellets and a 10% increase in the price of natural ore during 1979. The average weighted mine value of Minnesota iron ore shipped was $28.81 per ton in 1978 and $32.94 per ton in 1979.

Freight rates for transporting iron ore from the Mesabi Range to lower Lake ports increased from a range of $8.13 to $8.65 per long ton in mid-1978 to $8.69 to $9.42 in mid-1979. These rates included a dock handling charge of $0.51 per ton at upper Lake docks but did not include handling charges at lower Lake ports.

Transportation companies continued to increase the size of ore carriers used on the Great Lakes. Launching of two 1,000-foot ore carriers in 1979 brought the number of such vessels in service to eight; two more were under construction and another contracted for by yearend. The Federal Government's winter navigation program to assist year-round shipping on the Great Lakes was terminated in 1979. Since the project began in 1971, several 12-month seasons were achieved for iron ore shipments from the port of Two Harbors.

Research at the Twin Cities Research Center of the Federal Bureau of Mines included activities to expand the iron ore resource base and to develop new and improved processing technology. A report on the program researching methods of beneficiating the extensive nonmagnetic taconite resources of the Western Mesabi Range was published.[4]

At its Twin Cities Research Center, the Bureau of Mines installed and tested a coal gasifier, the product of which will be tested for effectiveness as a substitute for natural gas and oil now used in taconite-pelletizing operations. Equipment included a pilot-scale, 78-inch-diameter Wellman-Galusha gasifier and ancillary equipment, on lease from The Hanna Mining Co. Gas generated from Western subbituminous coal and bituminous coal from eastern Kentucky will be experimentally applied to pelletizing Marquette Range (Michigan) and Mesabi Range taconite. Uncertainty of future availability of large quantities of natural gas prompted the $2.5 million project, which is a joint effort of the Bureau of Mines, the Department of Energy, and 17 corporations with interests in iron and steel, coal, gas, and industrial engineering.

Iron and Steel.—North Star Steel Co. produced steel from ferrous scrap at its two electric furnaces in St. Paul. The company's Duluth plant, which produces forged alloy steel grinding balls mainly for use in taconite plants, had its first full year of operation during 1978.

Table 4.—Minnesota: Iron ore[1] data, by county

(Thousand long tons)

Year and county	Crude ore production[2]	Usable ore				
		Stocks Jan. 1	Production	Iron content of production	Shipments	Stocks Dec. 31
1978						
Itasca	20,996	W	6,334	3,851	6,074	W
St. Louis[3]	146,710	W	48,982	30,688	50,399	W
Total	167,706	6,560	55,316	34,539	56,473	5,402
1979						
Itasca	17,492	W	5,269	3,248	5,021	W
St. Louis[2]	166,311	W	54,051	33,976	54,661	W
Total[4]	183,803	5,441	59,320	37,223	59,682	5,079

W Withheld to avoid disclosing company proprietary data; included in "Total."
[1] Exclusive of ore containing 5% or more manganese.
[2] Entire production from Mesabi Range open pit mines.
[3] Includes Lake County.
[4] Data may not add to totals shown because of independent rounding.

Table 5.—Minnesota: Production and shipments of usable iron ore[1]

(Thousand long tons)

Year	Production				Shipments			
	Natural ore	Taconite pellets	Total[2]	Iron content (percent)	Natural ore	Taconite pellets	Total[2]	Proportion of taconite pellets to total ore (percent)
1975	10,466	40,711	51,177	60.58	10,553	38,615	49,167	78.54
1976	9,152	40,612	49,764	61.34	8,806	39,068	47,874	81.61
1977	4,600	26,343	30,943	61.91	5,123	25,122	30,245	83.06
1978	5,829	49,487	55,316	62.44	5,445	51,029	56,473	90.36
1979	4,028	55,292	59,320	62.75	3,626	56,056	59,682	93.92

[1] Exclusive of ore containing 5% or more manganese.
[2] Data may not add to totals shown because of independent rounding.

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Table 6.—Dates of first and final cargoes of Minnesota iron ore shipped from Upper Great Lakes ports

Port and dock	1977		1978		1979	
	First	Final	First	Final	First	Final
Duluth, Minn.: DM&IR	Apr. 6	Dec. 31	Apr. 11	Jan. 1[1]	Apr. 15	Dec. 27
Silver Bay, Minn.: Reserve	Apr. 11	Feb. 1[2]	Apr. 10	Jan. 11[1]	Apr. 21	Dec. 20
Superior, Wis.: Burlington-Northern	Apr. 18	Jan. 14[2]	Apr. 10	Jan. 11[1]	Apr. 19	Dec. 30
Taconite Harbor, Minn.: Erie	Apr. 25	Jan. 27[2]	Apr. 16	Jan. 12[1]	Apr. 20	Dec. 22
Two Harbors, Minn.: DM&IR	Mar. 21	(3)	(3)	(3)	(3)	Jan. 14[4]

[1] 1979.
[2] 1978.
[3] Vessel loadings at the DM&IR docks at Two Harbors continued without interruption during the 1977-79 shipping seasons.
[4] 1980.

Manganiferous Ore.—All production of manganiferous ore (containing 5% to 35% manganese, natural) in 1978-79 was from mines on the Cuyuna Range, operated by Pittsburgh Pacific Co., near Ironton in Crow Wing County.

Table 7.—Minnesota: Shipments of manganiferous ores[1] from the Cuyuna Range

Year	Ferruginous manganese ore (10% to 35% Mn, natural)		
	Quantity (long tons)	Content (natural)	
		Fe (percent)	Mn (percent)
1975	97,097	30.83	11.84
1976	180,599	27.00	12.80
1977	148,607	29.17	13.39
1978	226,249	28.22	12.98
1979	162,056	28.82	14.09

[1] All manganiferous ores shipped from the Cuyuna Range during 1975-79 were ferruginous manganese ore containing 10% to 35% manganese. There have been no shipments of manganiferous iron ore containing 5% to 10% manganese since 1969.

NONMETALS

Abrasive Stone.—The Jasper Stone Co. quarried quartzite from a deposit near Jasper in Rock County to produce grinding cubes and mill liner blocks. The product is used principally by industrial processing plants for grinding a variety of materials including silica flour, foundry sands, ceramic and pottery materials, feldspar, talc, gypsum, fertilizers, and paint pigments, and it is marketed throughout the United States and several foreign countries. Domestic shipments are primarily in bulk, with about 80% of the product handled by rail and the remainder by truck. Overseas shipment of cubes and liners require boxing.

Clays.—Common clay and shale were produced by Acolite, Inc., and Ochs Brick & Tile Co. near Springfield in Brown County, and by Aglite, Inc., near Minneapolis in Hennepin County. Most of the clay was converted to face brick and to lightweight aggregate used in the manufacture of concrete block.

Lime.—Lime was produced by American Crystal Sugar Co. at Moorhead in Clay County; at Crookston and East Grand Forks in Polk County; and at Renville in Renville County. All the lime produced was used by the company in its sugar refining operations at these same locations. The total lime consumed in the State from all U.S. sources during the biennium 1978-79 was approximately one-half million tons.

Peat.—Three companies produced peat from bogs in Aitkin, Carlton, and St. Louis Counties during 1979. Output increased slightly in quantity and total value over that of the previous year. The peat, which consisted of reed-sedge and sphagnum types, was sold for use in general soil improvement and other horticultural purposes. The bulk of the peat sold was marketed in package form.

Numerous studies and research projects were underway throughout 1978 and 1979 to determine the development potential of Minnesota's peat resources.

The Minnesota Department of Natural Resources completed an inventory of 7 million acres of peatlands by type, quantity, and quality of the peat in 1979. The study evaluated the feasibility and regional impact of various types of peat utilization (for example, horticultural, agricultural, industrial, chemical, gasification, direct-burning, etc.) and reclamation. Findings of the study were presented to the State Legislature for use in developing policy options for peatland management.

At midyear 1978, Minnesota Gas Co. (Minnegasco) concluded the initial phase of its program to explore the feasibility of developing a peat gasification operation in northern Minnesota. Favorable results were reported on laboratory tests conducted to produce synthetic natural gas from peat and the Department of Energy extended funding to Minnegasco to continue its research related to gasification in a pilot plant. Minnegasco has applied for a 25-year lease on 200,000 acres of State-owned peatland in northern Minnesota.

The Federal Bureau of Mines Twin Cities Research Center conducted research studies during 1978 and 1979 to develop methods for mining peat and reclaiming the land.

Perlite.—Perlite mined in other States was expanded by Conwed Corp. at its plant near Cloquet in Carlton County.

Sand and Gravel.—The quantity of sand and gravel produced in the State remained relatively constant during 1977 through 1979. Minnesota was in the top 20 percentile of States in the Nation in quantity of sand and gravel produced during the biennium 1978-79. More than 300 companies and government agencies, operating from about 400 sites, accounted for the 1978-79 production of construction sand and gravel and silica sand in the State. Approximately one-half of the production was obtained from seven counties that are geographically located to best supply the construction needs of the urban areas of Minneapolis-St. Paul, Moorhead, Duluth, and St. Cloud.

Silica sand was produced in Le Sueur and Washington Counties by the Unimin Corp. (formerly Unisil Corp.) and Twin City Silica, Inc. The Unimin Corp. completed construction of, and placed on stream in December 1979, its new $8 million silica-sand-processing plant at Ottawa in Le Sueur County. The new plant has an annual capacity of 675,000 tons, approximately double that of the old facility which is scheduled to be closed in May 1980. A variety of silica sand products for the foundry and glass-container industries in the Upper Midwest and for oil well fracturing are produced at the plant.

Most of the construction sand and gravel was shipped by truck with lesser amounts moved by barge and rail. Approximately two-thirds of the industrial sand was transported by rail and the remainder by truck.

Table 8.—Minnesota: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	9,577	$20,722	$2.16	9,282	$19,446	$2.10	9,802	$21,172	$2.16
Plaster and gunite sands	NA	NA	NA	240	643	2.67	295	782	2.65
Concrete products	2,977	6,666	2.24	3,072	6,333	2.06	2,141	4,598	2.15
Asphaltic concrete	4,861	8,402	1.73	4,820	8,175	1.70	5,291	8,652	1.64
Roadbase and coverings	8,710	14,289	1.64	8,995	14,869	1.65	8,452	13,939	1.65
Fill	3,418	3,497	1.02	3,778	3,996	1.06	4,117	4,575	1.11
Snow and ice control	NA	NA	NA	244	383	1.57	257	424	1.65
Railroad ballast	15	24	1.64	10	26	2.54	9	35	3.90
Other uses	473	696	1.47	639	1,097	1.72	575	1,251	2.17
Total[1] or average	30,030	54,297	1.81	31,080	54,967	1.77	30,939	55,427	1.79

NA Not available.

[1] Data may not add to totals shown because of independent rounding.

Table 9.—Minnesota: Construction and industrial sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	9,883	$16,196	$1.64	13,328	$21,488	$1.61	11,046	$18,491	$1.67
Gravel	20,147	38,101	1.89	17,752	33,479	1.89	19,893	36,936	1.86
Total or average	30,030	54,297	1.81	31,080	[1]54,970	1.77	30,939	55,427	1.79
Industrial sand	683	5,332	7.80	W	W	W	W	W	W
Grand total or average	30,713	59,629	1.94	W	W	W	W	W	W

W Withheld to avoid disclosing company proprietary data.

[1] Data do not add to total shown because of independent rounding.

Table 10.—Minnesota: Sand and gravel sold or used by producers, by county[1]

(Thousand short tons and thousand dollars)

County	1977			1978[2]			1979[2]		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Aitkin	4	49	72	4	65	101	3	24	35
Anoka	2	W	W	1	W	W	1	W	432
Becker	7	266	479	6	249	452	4	110	220
Beltrami	6	213	523	4	107	248	4	150	299
Benton	--	--	--	2	W	W	3	96	161
Brown	3	243	461	4	582	1,010	3	469	796
Carlton	8	313	456	8	300	435	6	229	346
Cass	7	270	465	6	75	159	4	216	903
Chippewa	5	286	495	4	283	455	4	163	228
Chisago	3	137	345	5	158	280	3	170	270
Clay	12	1,593	3,156	12	1,094	1,496	12	3,440	5,329
Clearwater	4	158	237	4	64	100	3	70	137
Cook	2	139	216	2	W	42	2	W	55
Cottonwood	4	165	230	3	125	199	2	W	W
Crow Wing	12	353	712	14	425	788	9	297	652
Dakota	13	2,510	4,323	11	2,900	4,825	10	1,948	3,787
Dodge	1	10	15	2	W	W	1	W	W
Douglas	7	213	450	7	303	651	5	231	498
Fillmore	3	42	75	3	102	198	3	122	192
Freeborn	9	498	965	9	477	834	8	480	819
Goodhue	7	218	351	6	204	306	6	408	582
Grant	1	3	5	1	W	W	1	W	W
Hennepin	20	3,263	5,312	20	3,845	6,377	18	4,320	6,968
Hubbard	5	195	340	5	174	361	5	146	399
Isanti	--	--	--	1	75	143	--	--	--
Itasca	10	1,050	2,134	9	683	1,365	5	633	1,424
Kanabec	3	127	258	2	W	W	4	121	153
Kandiyohi	5	700	1,215	3	506	913	4	508	1,056
Kittson	3	302	551	5	302	491	4	279	453
Koochiching	9	270	418	9	203	331	8	213	378
Lac qui Parle	2	W	W	2	79	W	1	41	W
Lake	3	216	312	3	190	331	3	175	268
Lake of the Woods	1	52	78	1	52	78	1	52	78
Le Sueur	5	1,161	3,881	4	W	W	3	W	W
Lincoln	1	7	11	1	7	11	1	7	11
Lyon	1	50	75	1	50	75	1	W	W
McLeod	4	57	85	4	106	159	2	13	19
Mahnomen	2	53	80	2	103	130	2	129	240
Marshall	4	136	260	5	237	397	6	242	328
Martin	1	5	8	--	--	--	--	--	--
Meeker	3	154	248	3	233	278	3	249	335
Mille Lacs	6	248	397	3	152	262	3	150	320
Morrison	6	912	2,098	7	596	1,866	5	229	403
Mower	3	76	143	3	88	201	3	97	247
Murray	2	42	63	5	52	85	5	26	27
Nicollet	3	288	534	2	W	W	2	W	W
Norman	3	226	291	4	285	382	4	217	271
Olmsted	4	490	871	4	613	1,257	3	478	991
Otter Tail	7	263	411	8	146	216	8	209	269
Pennington	2	115	205	2	W	W	2	144	243
Pine	2	W	W	1	W	W	3	67	160
Polk	7	434	725	7	561	967	8	473	742
Pope	3	67	131	3	138	296	3	114	227
Red Lake	1	3	5	1	3	5	1	3	5
Redwood	5	317	469	3	143	218	3	98	148
Renville	3	420	651	2	W	W	2	W	W
Rice	7	554	3,201	6	488	669	6	467	641
Roseau	1	3	5	1	3	5	2	W	W
St. Louis	46	1,764	3,183	35	1,895	2,643	23	1,101	2,440
Scott	4	405	628	4	316	476	3	455	717
Sherburne	9	945	1,687	9	1,298	2,815	9	1,449	2,983
Sibley	3	55	82	2	W	W	2	W	W
Stearns	6	220	405	5	215	398	5	165	295
Steele	6	406	732	6	385	624	5	404	696
Swift	1	97	146	1	106	178	1	128	W
Todd	7	349	564	9	279	476	9	325	569
Wabasha	3	179	287	4	339	566	3	181	344
Wadena	2	W	W	1	104	161	1	8	10
Waseca	1	100	150	1	100	150	1	W	W
Washington	20	2,866	6,249	17	W	W	16	W	W
Watonwan	4	64	142	5	19	31	3	67	121
Wilkin	3	115	171	4	247	344	3	128	158
Winona	4	447	968	3	374	846	4	334	967
Wright	10	426	774	8	372	755	7	350	685
Yellow Medicine	3	27	42	3	98	157	3	W	W
Undistributed[3]	[r]16	2,311	3,928	16	7,805	13,898	17	7,311	12,894
Total[4]	415	30,713	59,629	393	31,080	54,967	346	30,939	55,427

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed".

[1] Pipestone and Traverse Counties are not listed because no production was reported.

[2] Data for 1978 and 1979 exclude industrial sand to avoid disclosing company proprietary data.

[3] Includes Big Stone, Blue Earth, Carver, Faribault, Houston, Jackson (1979), Nobles, Ramsey, Rock, and Stevens Counties, and some sand and gravel that cannot be assigned to specific counties, and data indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

Stone.—Granite, limestone, quartzite, and traprock were produced in 25 counties during 1978-79. Production was obtained from approximately 100 quarry sites, operated by more than 40 firms.

Limestone, marketed as crushed material, was quarried from deposits in 14 south-central and southeastern counties during the biennium. Scott County was the leader in output. The crushed limestone was used most extensively as a dense roadbase material. Dimension limestone was produced at four quarries in Blue Earth, Le Sueur, and Winona Counties, with over half of the total output marketed as cut stone and house stone veneer.

Granite was quarried by 7 companies operating 15 quarries located in 8 counties during the biennium. Stearns County ranked first in production of both dimension and crushed granite. Dimension granite was used principally for monuments and the crushed granite most extensively for railroad ballast.

Jasper Stone Co. produced dimension quartzite at its quarry in Rock County mainly for its own use in manufacturing grinding pebbles and tube-mill liners. Crushed and broken quartzite was produced at the Nicollet County quarry of New Ulm Quartzite Quarries, Inc., and used primarily as an aggregate in concrete.

Arrowhead Blacktop Co. quarried and crushed traprock at a site in St. Louis County for bituminous aggregate, dense roadbase material, riprap, and railroad ballast.

Four firms provided approximately half of the State's stone output in the biennium. Production from individual quarries ranged from less than 25,000 tons to more than 1 million tons per year. The bulk of the shipments of crushed stone were handled by truck.

Sulfur (Recovered Elemental).—Elemental sulfur was recovered as a byproduct of the petroleum-refining operations of Koch Refining Co., a Division of Koch Industries, Inc., near Pine Bend in Dakota County, and Northwestern Refining Co., a Division of Ashland Oil Co., Inc., near St. Paul Park in Washington County.

Table 11.—Minnesota: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	431	1,034	555	1,346	383	959
Concrete aggregate (coarse)	[2]715	[2]1,893	963	2,492	740	1,955
Bituminous aggregate	611	1,367	539	1,093	459	1,129
Macadam aggregate	W	279	W	273	137	336
Dense graded roadbase stone	2,700	5,199	3,107	6,054	3,074	6,199
Surface treatment aggregate	414	782	577	1,139	514	881
Other construction aggregate and roadstone	737	1,633	1,183	2,435	1,807	4,270
Riprap and jetty stone	136	296	102	247	100	322
Railroad ballast	1,595	3,518	1,996	4,321	2,000	4,850
Filter stone	[r]11	24	W	W	11	27
Asphalt filler	W	W	W	W	117	519
Other uses[3]	[r]481	966	644	1,335	409	728
Total[4]	7,831	16,991	9,666	20,734	9,751	22,175

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes granite, limestone, quartzite, and traprock.

[2] Includes manufactured fine aggregate (stone sand).

[3] Includes stone used for fill (1978-79), manufactured fine aggregate (stone sand, 1978), poultry grit and mineral food, terrazzo (1979), other miscellaneous uses, and uses indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

Table 12.—Minnesota: Dimension stone[1] sold or used by producers, by use

Use	1977			1978			1979		
	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)
Rough stone:									
Rough blocks	2,284	27	$155	W	W	W	W	W	W
Other rough stone[2]	6,419	67	268	8,668	94	$417	6,777	73	$332
Dressed stone:									
Cut stone	[r]13,098	159	4,688	14,595	180	5,642	16,834	204	6,726
House stone veneer	W	W	W	W	W	W	4,066	51	409
Other dressed stone[3]	11,580	142	3,023	11,580	142	3,266	10,769	130	4,085
Total[4]	33,376	395	8,133	34,843	416	9,356	38,446	458	11,543

[r] Revised. W Withheld to avoid disclosing company proprietary data.

[1] Includes granite, limestone, and quartzite.

[2] Includes rough blocks (1978-79), irregular shaped stone (1978), rubble, rough monumental, rough flagging (1977 and 1979), and other rough stone.

[3] Includes sawed stone, house stone veneer (1977-78), dressed monumental, dressed flagging, and other dressed stone.

[4] Data do not add to total shown because of independent rounding.

Table 13.—Minnesota: Crushed limestone sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1977			1978			1979		
	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value	Number of quarries	Quantity	Value
Blue Earth	4	511	924	4	662	1,263	2	W	W
Dakota	2	354	725	2	W	W	3	323	778
Fillmore	9	448	1,023	5	263	727	6	436	1,313
Goodhue	7	120	207	7	176	321	7	171	317
Houston	11	W	W	15	429	1,067	12	W	W
Mower	3	W	W	3	464	1,183	1	173	311
Olmsted	10	801	1,731	8	979	1,951	7	W	W
Rice	--	--	--	1	48	72	1	50	81
Scott	4	1,080	2,186	4	1,492	2,828	4	1,953	3,739
Wabasha	7	204	382	6	203	397	8	267	454
Washington	4	793	1,641	4	1,021	2,148	4	1,247	2,736
Winona	9	W	W	13	302	566	16	405	886
Wright	--	--	--	--	--	--	1	22	W
Undistributed[1]	[r]5	1,158	2,513	5	956	2,018	4	2,021	4,715
Total[2]	75	5,469	11,330	77	6,997	14,541	76	7,068	15,330

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes Dodge and Steele Counties and data indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Vermiculite.—Crude vermiculite obtained from other States was exfoliated by three companies at plants in Hennepin and Ramsey Counties. The expanded material was used mainly for loose fill and block insulation, with lesser quantities used for plaster aggregate, horticultural purposes, and fireproofing.

Vermiculite processing operations were discontinued in May 1979 at MacArthur Co.'s St. Paul processing plant, which had been operated by Nawrocki Insulation since November 1978.

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[1] State mineral specialist, Bureau of Mines, Twin Cities, Minn.

[2] Program assistant, Bureau of Mines, Twin Cities, Minn.

[3] Minnesota Department of Economic Development. Feasibility Study, Cement Production. December 1979, 55 pp.

[4] Colombo, A. F., H. D. Jacobs, and D. M. Hopstock. Beneficiation of Western Mesabi Range Oxidized Taconite. BuMines RI 8325, 1978, 13 pp.

Table 14.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasive stone: Jasper Stone Co	14575 Garden Rd. Golden, CO 80401	Quarry and plant	Rock.
Clay and shale:			
Acolite, Inc	Box 106 Springfield, MN 56087	Pit and plant	Brown
Aglite, Inc	4901 West Medicine Lake Dr. Minneapolis, MN 55442	do	Hennepin.
Ochs Brick & Tile Co	Box 106 Springfield, MN 56087	do	Brown and Redwood.
Iron ore:			
Cleveland-Cliffs Iron Co.: Canisteo	1460 Union Commerce Bldg. Cleveland, OH 44115	Mine and concentrator	Itasca.
The Hanna Mining Co.:	100 Erieview Plaza Cleveland, OH 44114		
Butler Taconite Project		Mine, concentrator, and agglomerator.	Do.
National Steel Pellet Project		do	Itasca and St. Louis.
Whitney		Stockpile shipments	St. Louis.
Inland Steel Mining Co.: Minorca	30 West Monroe St. Chicago, IL 60603	Mine, concentrator, and agglomerator.	Do.
Jones & Laughlin Steel Corp. Northwest Ore Div.:	Virginia, MN 55792		
Hill Annex, Trumbull, and Delaware		Mines and concentrator	Itasca.
McKinley and Welton		do	St. Louis.
Oglebay-Norton Co.:	1200 Hanna Bldg. Cleveland, OH 44115		
Thunderbird		Mine	Do.
Fairlane plant		Concentrator and agglomerator.	Do.
Pickands Mather & Co.:	1100 Superior Ave. Cleveland, OH 44114		
Erie Commercial		Mine, concentrator, and agglomerator.	Do.
Hibbing Taconite		do	Do.
Pittsburgh Pacific Co.:	2521 1st Ave. Hibbing, MN 55746		
Connie, Rouchleau, and others		Mines	Do.
Julia plant		Concentrator	Do.
Reserve Mining Co.:	Silver Bay, MN 55614		
Peter Mitchell		Mine and primary crusher	Do.
Silver Bay plant		Concentrator and agglomerator.	Lake.
Rhude & Fryberger, Inc.:	Box 66 Hibbing, MN 55746		
Gross-Nelson, Leonidas, Sharon-Culver, and Wabigon.		Mines and concentrators	St. Louis.
Hull-Rust		Stockpile shipments	Do.
Snyder Mining Co.:	Box 730 Buhl, MN 55713		
Whiteside		do	Do.
United States Steel Corp. Minnesota Ore Operations:	Box 417 Mountain Iron, MN 55768		
Minntac		Mine, concentrator, and agglomerator	Do.
Plummer group		Mine and concentrator	Itasca.
Rouchleau group		do	St. Louis.
Sherman group		do	Do.
Iron and steel:			
North Star Steel Co	1678 Red Rock Rd. St. Paul, MN 55164	Electric steel furnace	Ramsey.
Lime:			
American Crystal Sugar Co	101 North Third St. Moorhead, MN 56560	Quicklime; shaft kilns	Clay, Polk, Renville.
Manganiferous ore:			
Pittsburgh Pacific Co.:	2521 1st Ave. Hibbing, MN 55746		
Algoma-Zeno		Mine and concentrator	Crow Wing.
Peat:			
Michigan Peat	Box 3006 Houston, TX 77001	Bog; processing plant	Carlton.
Northern Peat Co	Box 416 Grand Rapids, MN 55744	do	Aitkin.
Power-O-Peat Co	Box 956 Gilbert, MN 55741	do	St. Louis.
Sand and gravel:			
Arsenal Sand & Gravel Co	Box 2707 New Brighton, MN 55112	Pit and plant	Ramsey.
Barton Contracting Co	10300 89th Ave. N. Osseo, MN 55369	Pits and plants	Hennepin, Sherburne, Washington, Wright.

Table 14.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel —Continued			
Carlson Brothers, Inc	P. O. Box 141 Springfield, MN 56087	Pit and plant	Brown.
Cemstone Products Co	1520 Minnehaha Ave. St. Paul, MN 55106	do	Washington.
E. W. Coons Co	Box 390 Hibbing, MN 55746	Pits and plants	Itasca and St. Louis.
Duininck Bros. & Gilchrist	Prinsburg, MN 56281	do	Kandiyohi, Kittson, Renville.
Fischer Sand & Aggregate Inc	6801 West 150th St. Apple Valley, MN 55124	Pit and plant	Dakota.
Kost Bros, Inc	Box 499 Moorhead, MN 56560	Pits and plants	Clay.
William Mueller & Sons Co	Hamburg, MN 55339	do	Carver, McLeod, Sibley.
North Star Concrete Co	Box 167 Mankato, MN 56001	do	Le Sueur and Nicollet.
Northwestern Aggregates, Inc., a Division of Model Stone Co.	Box 1248 Burnsville, MN 55337	Pit and plant	Dakota.
Shakopee Sand & Gravel Co., a Division of Oscar Roberts Co.	8301 77th Ave. North Brooklyn Center, MN 55445	Pits and plants	Dakota and Hennepin.
J. L. Shiely Co	1101 North Snelling Ave. St. Paul, MN 55108	Pit and plant	Washington.
Unisil Corp	Greenwich Office Park 4 Greenwich, CT 06830	Pit and plant; industrial sand.	Le Sueur.
Stone:			
Granite:			
Cold Spring Granite Co	Cold Spring, MN 56320	Quarries	Big Stone, Mille Lacs, Renville, St. Louis.
Do		Quarries and plant	Stearns.
The Green Co., Inc	200 14th Ave. Granite Falls, MN 56421	Quarry and plant	Yellow Medicine.
Ortonville Stone Co., a Subsidiary of L. G. Everist Inc.	Box 829 Sioux Falls, SD 57102	do	Big Stone.
J. L. Shiely Co	1101 North Snelling Ave. St. Paul, MN 55108	do	Stearns.
Limestone:			
Biesanz Stone Co., Inc	Box 768 Winona, MN 55987	do	Winona.
Bryan Rock Products, Inc	Box 215 Shakopee, MN 55379	Quarries and plants	Scott and Washington.
Hector Construction Co	Box 410 Caledonia, MN 55921	do	Houston and Winona.
Edward Kraemer & Sons, Inc	1000 West 122nd St. Burnsville, MN 55378	Quarry and plant	Dakota.
Mankato Aglime & Rock Co	Box 254 Mankato, MN 56001	do	Blue Earth.
Mankato Stone Center, a Division of the Babcock Co.	Box 3088 Mankato, MN 56001	do	Do.
Osmundson Brothers	Adams, MN 55909	Quarries and plants	Mower.
Quarve & Anderson Co	2430 Marion Rd. SE. Rochester, MN 55901	do	Dodge, Fillmore, Goodhue, Olmsted, Wabasha, Winona.
River Warren Aggregates, Inc	Box 122 Chaska, MN 55318	Quarry and plant	Scott.
J. L. Shiely Co	1101 North Snelling Ave. St. Paul, MN 55108	Quarries and plants	Scott and Washington.
Stussy Construction, Inc	Box 187 Mantorville, MN 55955	Quarry and plant	Dodge.
Vetter Stone Co	Route 5 Mankato, MN 56001	Quarries and plants	Blue Earth and Le Sueur.
Quartzite:			
Jasper Stone Co	Jasper, MN 56144	Quarry and plant	Rock.
New Ulm Quartzite Quarries, Inc	Route 3, Box 21 New Ulm, MN 56073	do	Nicollet.
Traprock (basalt):			
Arrowhead Blacktop Co	Box 6568 Duluth, MN 55806	do	St. Louis.
Sulfur, recovered elemental:			
Koch Refining Co., a Division of Koch Industries, Inc.	Box 2302 Wichita, KS 67201	Elemental sulfur recovered as a byproduct of oil refining.	Dakota.
Northwestern Refining Co., a Division of Ashland Oil, Inc.	Drawer 9 St. Paul Park, MN 55071	do	Washington.
Vermiculite, exfoliated:			
Construction Products Div., W. R. Grace & Co.	62 Whittemore Ave. Cambridge, MA 02140	Processing plant	Hennepin.
Diversified Insulation, Inc	Box 188 Hamel, MN 55340	do	Do.

The Mineral Industry of Mississippi

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Bureau of Geology and Energy Resources, Mississippi Department of Natural Resources, for collecting information on all nonfuel minerals.

By James R. Boyle[1] and Alvin R. Bicker[2]

The value of Mississippi's nonfuel mineral production in 1978 and 1979 was $96.8 million and $107.7 million, respectively. In 1978, significant increases in production and value were recorded in most construction materials. Production in 1979 remained about the same as in 1978, with some unit value increases. In 1978, Mississippi ranked second in the production of bentonite and recovered sulfur; third in ball clay and fuller's earth; and fifth in the recovery of magnesium compounds from seawater.

Table 1.—Nonfuel mineral production in Mississippi[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ________ thousand short tons __	[2]1,483	[2]$8,841	1,960	$19,623	1,820	$21,841
Lime ________________________ do ____	49	1,079	49	1,108	70	1,571
Sand and gravel[3] ____________ do ____	13,353	25,375	15,960	33,520	16,940	37,797
Stone (crushed) ______________ do ____	2,176	3,933	2,409	5,176	W	W
Combined value of cement, clays (ball clay and fuller's earth, 1977), magnesium compounds, sand and gravel (industrial), and values indicated by symbol W ________________	XX	38,240	XX	37,397	XX	46,480
Total ______________________	XX	77,468	XX	96,824	XX	107,689

W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes ball clay and fuller's earth; value included in "Combined value" figure.

[3] Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Mississippi, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Adams	--	W	Sand and gravel.
Benton	W	W	Clays.
Bolivar	$263	$230	Sand and gravel.
Carroll	W	W	Sand and gravel, clays.
Chickasaw	264	73	Stone.
Clay	W	W	Stone, sand and gravel.
Copiah	4,264	5,407	Sand and gravel.
DeSoto	263	1,826	Do.
Forrest	W	W	Do.
George	36	61	Do.
Grenada	--	W	Do.
Hancock	374	569	Do.
Harrison	W	180	Do.
Hinds	W	W	Clays.
Holmes	2,077	2,305	Sand and gravel.
Itawamba	W	W	Clays, sand and gravel.
Jackson	W	W	Magnesium compounds, lime.
Jefferson Davis	101	40	Sand and gravel.
Jones	W	W	Clays.
Kemper	W	W	Do.
Lauderdale	W	W	Do.
Lee	W	W	Sand and gravel.
Lincoln	125	W	Clays, sand and gravel.
Lowndes	20,133	22,614	Cement, sand and gravel, stone, clays.
Marion	611	579	Sand and gravel.
Marshall	W	W	Clays.
Monroe	W	W	Clays, sand and gravel.
Newton	--	W	Sand and gravel.
Noxubee	W	W	Clays, stone.
Panola	W	W	Clays, sand and gravel.
Perry	W	498	Sand and gravel.
Pike	875	875	Do.
Prentiss	W	W	Clays.
Quitman	W	W	Do.
Rankin	W	W	Cement, stone, clays.
Smith	W	W	Clays.
Stone	815	805	Sand and gravel.
Sunflower	14	17	Clays.
Tate	285	W	Sand and gravel.
Tippah	W	W	Clays.
Tishomingo	W	W	Stone, sand and gravel.
Walthall	200	10	Sand and gravel.
Warren	1,660	W	Do.
Washington	W	W	Do.
Wayne	--	343	Stone.
Winston	W	W	Clays.
Yalobusha	W	794	Sand and gravel.
Yazoo	1,623	3,183	Do.
Undistributed[2]	43,485	56,460	
Total	[3]77,468	96,824	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] The following counties were not listed because no nonfuel mineral production was reported: Alcorn, Amite, Attala, Calhoun, Choctaw, Claiborne, Clarke, Coahoma, Covington, Franklin, Greene, Humphreys, Issaquena, Jasper, Jefferson, Lafayette, Lamar, Lawrence, Leake, Leflore, Madison, Montgomery, Neshoba, Oktibbeha, Pearl River, Pontotoc, Scott, Sharkey, Simpson, Tallahatchie, Tunica, Union, Webster, and Wilkinson.

[2] Includes nonfuel mineral production that cannot be assigned to specific counties and values indicated by symbol W.

[3] Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Mississippi business activity

	1977	1978	1979^p	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	961.0	969.0	987.0	+1.9
Unemployment do	71.0	68.0	57.0	-16.2
Employment (nonagricultural):				
Mining do	7.6	8.6	9.4	+9.3
Manufacturing do	230.1	235.3	235.2	--
Contract construction do	41.0	44.9	46.9	+4.5
Transportation and public utilities do	36.1	38.5	41.2	+7.0

See footnotes at end of table.

Table 3.—Indicators of Mississippi business activity —Continued

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average —Continued				
Employment (nonagricultural) —Continued				
Wholesale and retail trade ______ thousands	149.7	159.4	163.0	+2.3
Finance, insurance, real estate ______ do	29.7	31.4	32.7	+4.1
Services ______ do	107.9	113.9	117.8	+3.4
Government ______ do	163.9	181.8	192.4	+5.8
Total nonagricultural employment[1] ______ do	765.9	[2]813.7	838.6	+3.1
Personal income:				
Total ______ millions	$11,955	$13,411	$14,979	+11.6
Per capita ______	$5,011	$5,582	$6,167	+10.5
Construction activity:				
Number of private and public residential units authorized ______	8,231	[3]10,748	8,501	-20.9
Value of nonresidential construction ______ millions	$143.3	$109.6	$113.8	+3.8
Value of State road contract awards ______ do	$125.0	NA	$108.0	--
Shipments of portland and masonry cement to and within the State ______ thousand short tons	1,020	1,106	1,023	-7.5
Nonfuel mineral production value:				
Total crude mineral value ______ millions	$77.5	$96.8	$107.7	+11.2
Value per capita, resident population ______	$32	$40	$44	+10.0
Value per square mile ______	$1,624	$2,029	$2,257	+11.2

[p] Preliminary. NA Not available.
[1] Includes oil and gas extraction.
[2] Data do not add to total shown because of independent rounding.
[3] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

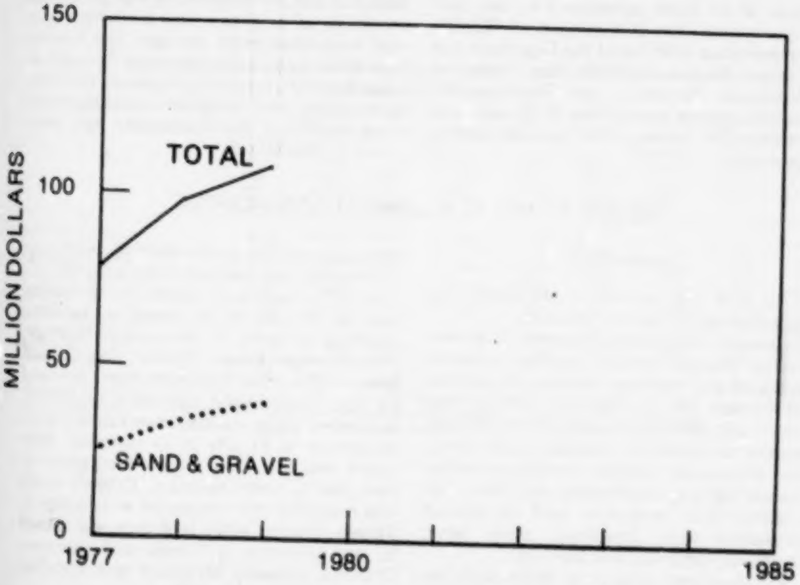

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in Mississippi.

Trends and Developments.—In 1979, the Port of Gulfport dedicated the world's first catenary continuous bulk unloader and multi-purpose Portainer crane. The crane handles containers, discharges bulk cargo with a continuous unloader, handles heavy lifts, and also handles magnet and general cargo work. The original need was for unloading ilmenite ore imported from Australia. The ilmenite is stored in a silo at Gulfport and then transported to a newly constructed pigment plant of E.I. duPont de Nemours & Co., 10 miles away. The first shipment unloaded was 21,596 long tons of ilmenite. The unloader can also handle iron ore pellets, ore concentrates, coal, and sand and gravel. The site of the new unloader at Gulfport is owned by the State and administered by the Agricultural and Industrial Board. The port, which is relatively small, handled 33,163 tons of ilmenite, 6,201 tons of fertilizers, and other commodities during the fiscal year ending October 1, 1979.

Legislation and Government Programs.—In 1978, the State legislature passed a bill which consolidated the functions of 16 State agencies into two new departments, the Department of Wildlife Conservation (DWC) and the Department of Natural Resources (DNR). The Mississippi Geological, Economic, and Topographical Survey became part of the DNR, and was renamed the Bureau of Geology and Energy Resources.

The Mississippi Surface Mining and Reclamation Act was passed by the 1977 Session and became effective April 15, 1978. The Mississippi Geological, Economic, and Topographical Survey was named to administer the act and to promulgate rules and regulations to implement the act. Exempted from the act are sand and gravel operations affecting less than 4 acres.

The U.S. Secretary of the Interior designated the University of Mississippi as a State Mining and Minerals Resources Research Institute under the Surface Mining Control and Reclamation Act of 1977. Such institutes are to establish training programs in mining and minerals extraction, and provide scholarships and fellowships. Each institute initially received a basic grant of $110,000 plus $160,000 for scholarships and grants.

The State Bureau of Geology and Energy Resources assessed potential environmental hazards associated with surface impoundments for the U.S. Environmental Protection Agency. The Survey continued to investigate and furnish data to the the State Board of Health concerning the geological feasibility of proposed sites for solid waste and hazardous waste storage. The Survey completed an open file report on Pennsylvanian Age coal, conducted regional structural mapping, and compiled a stratigraphic cross section of the Cretaceous Age sediments in Mississippi.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

All minerals mined in the State are classified as nonmetallic minerals.

Cement.—Marquette Cement Manufacturing Co., in Rankin County, produced portland and masonry cement, while United Cement Co., in Lowndes County, produced only portland cement. Principal consumers for portland cement include ready-mix companies, concrete products manufacturers, highway contractors, and other contractors. Raw materials used by cement producers were limestone, marl, sand, chalk, clay, gypsum, and iron ore.

Clays.—Clays mined in Mississippi included ball clay, bentonite, fuller's earth, and common clay. The State ranked second nationally in the production of bentonite, and third in ball clay and fuller's earth.

In 1978, clays were mined by 22 companies at 29 pits in 20 counties. Leading counties, in order of decreasing tonnage, were Noxubee, Hinds, Monroe, Tippah, and Kemper Counties. Common clay was used for brick, lightweight aggregate, drain tile, and sewer pipe; the clay was mined by 16 companies at 21 pits in 14 counties. Bentonite was mined by three companies at four pits in three counties. Fuller's earth was mined by two companies at two pits in Tippah County, while ball clay was mined by one company in Panola and Quitman Counties. Industry structure and distribution were similar for 1979.

Table 4.—Mississippi: Clays sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Year	Bentonite		Ball clay, fire clay, and fuller's earth		Common clay		Total[1]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1975	264	4,607	176	4,024	1,152	1,975	1,592	10,605
1976	373	6,740	W	W	1,114	2,110	1,487	8,849
1977	340	6,389	W	W	1,143	2,452	1,483	8,841
1978	358	7,742	W	W	1,356	3,084	1,960	19,623
1979	318	7,128	W	W	1,221	3,162	1,820	21,841

W Withheld to avoid disclosing company proprietary data.

[1] Data may not add to totals shown because of independent rounding.

Lime.—Corchem, Inc., produced quicklime at Pascagoula in Jackson County from stone quarried in Alabama. The lime was used in the production of magnesite.

Magnesium Compounds.—Corhart Refractories Co. recovered magnesium compounds from seawater at Pascagoula. The magnesium compounds were used in the manufacture of refractories. Mississippi ranked fifth nationally in recovery of magnesium compounds from seawater.

Perlite.—Johns-Manville Corp., Natchez, and U.S. Gypsum Co., Greenville, expanded perlite imported from out of State. The product was used in roof insulation and for formed products.

Sand and Gravel.—Sand and gravel was the leading commodity in value among the nonfuel minerals produced in Mississippi. Production of sand and gravel in 1978 was reported by 78 companies from 96 pits located in 31 counties. Leading producing counties were Copiah, Yazoo, Monroe, Holmes, and Adams. Industry output in 1979 was comparable to that of 1978.

Table 5.—Mississippi: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	5,950	$11,870	$1.99	6,227	$13,478	$2.16	6,187	$14,992	$2.42
Plaster and gunite sands	NA	NA	NA	W	W	W	W	W	W
Concrete products	1,338	3,194	2.39	591	1,517	2.57	467	1,345	2.88
Asphaltic concrete	1,941	3,479	1.79	2,761	6,602	2.39	3,780	8,872	2.35
Roadbase and coverings	3,134	5,457	1.74	5,618	10,783	1.92	5,472	10,772	1.97
Fill	890	1,154	1.30	657	973	1.48	932	1,561	1.68
Snow and ice control	NA	NA	NA	--	--	--	1	1	1.00
Railroad ballast	--	--	--	2	4	2.20	2	4	2.20
Other uses	99	222	2.24	95	159	1.67	100	250	2.49
Total[1] or average	13,358	25,375	1.90	15,950	33,520	2.10	16,940	37,797	2.23

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Data may not add to totals shown because of independent rounding.

Table 6.—Mississippi: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	4,208	$7,045	$1.67	5,248	$9,755	$1.86	5,888	$11,066	$1.88
Gravel	9,145	18,330	2.00	10,703	23,760	2.22	11,051	26,731	2.42
Total or average	13,353	25,375	1.90	15,950	33,520	2.10	16,940	37,797	2.23
Industrial sand	W	W	W	W	W	W	W	W	W
Grand total[1] or average	W	W	W	W	W	W	W	W	W

W Withheld to avoid disclosing company proprietary data.
[1]Data may not add to totals shown because of independent rounding.

Stone.—In 1978, six companies crushed limestone and marl at eight quarries in seven counties. Stone was used for cement manufacture, agricultural limestone, riprap, concrete aggregate, and other uses; leading producers were United Cement Co., a division of Texas Industries, Inc.; Mississippi Stone Co., Inc.; and Marquette Cement Manufacturing Co. The majority of shipments were made by truck, with a small amount by railroad. Of the eight quarries, three produced in excess of 500,000 tons per year, which accounted for nearly three-fourths of the State's total production. Leading counties were Lowndes, Tishomingo, and Rankin. Industry structure and output for 1979 was comparable to 1978.

Sulfur.—Recovery of sulfur from refinery and natural gases was reported by Shell Oil Co. in Clarke and Rankin Counties; by Chevron, USA, Inc., in Jackson County; and by Gulf Oil Corp., in Lamar County. Sulfur sold or used in 1978 totaled 516,839 metric tons valued at $24.9 million; in 1979, production increased to 562,800 metric tons valued at $35.6 million. Pursue Gas Processing and Petrochemical Co. announced plans for construction of one of the largest sulfur recovery plants in the Nation. The plant, to be built near Jackson, will process about 100 million cubic feet of gas per day from the Thomasville Field near Jackson. The plant is expected to recover about 1,280 long tons of sulfur per day. Startup is scheduled for the third quarter of 1980.

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[1]State mineral specialist, Bureau of Mines, Tuscaloosa, Ala.
[2]State geologist, Bureau of Geology and Energy Resources, Jackson, Miss.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Marquette Cement Manufacturing Co	20 North Wacker Dr. Chicago, IL 60606	Plant	Rankin.
United Cement Co	Box 185 Artesia, MS 39736	do	Lowndes.
Clays:			
Delta-Macon Brick and Tile Co., Inc	RFD 3, Box 2 Macon, MS 39341	Mine and plant	Noxubee.
International Minerals & Chemical Corp	Box 346A Aberdeen, MS 39730	Mine	Monroe.
Jackson Ready Mix Concrete, a division of Delta Industries, Inc.	Box 1292 Jackson, MS 39205	do	Hinds.
Oil-Dri Production Co	Box 476 Ripley, MS 38663	Mine and plant	Tippah.
Tri-State Brick and Tile Co., Inc	Box 9787 Jackson, MS 39206	do	Hinds.
Lime:			
Corchem, Inc	Box 1707 Pascagoula, MS 39567	Plant	Jackson.
Magnesium compounds:			
Corhart Refractories Co.	1600 West Lee St. Louisville, KY 40212	do	Do.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel:			
American Sand & Gravel Co	Box 272 Hattiesburg, MS 39401	Stationary plant	Forrest.
Blain Gravel Co	Box 268 Crystal Springs, MS 39059	do	Copiah.
Green Bros. Gravel Co., Inc.	Route 4, Box 17 Franklinton, LA 70438	do	Do.
Hammett Gravel Co	Box 207 Lexington, MS 39095	Mine and plant	Holmes.
Warren Brothers Co. (Ashland-One, Inc. - Div. of Ashland Oil, Inc.)	Tower Pl. 3340 Peachtree Rd. Atlanta, GA 30326	Mines and plants	Hinds, Lowndes, Yazoo.
Stone:			
Marquette Cement Manufacturing Co	20 North Wacker Dr. Chicago, IL 60606	Quarry	Rankin.
Mississippi Stone Products	Box 336 Iuka, MS 38852	do	Tishomingo.
State Dept. of Agriculture and Commerce	Box 352 West Point, MS 39773	do	Clay, Noxubee, Wayne.
United Cement	Box 185 Artesia, MS 39736	do	Lowndes.

The Mineral Industry of Missouri

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Missouri Department of Natural Resources, Division of Geology and Land Survey, for collecting information on all nonfuel minerals.

By Robert H. Arndt[1]

A new record was established for nonfuel minerals produced in Missouri when mineral output in 1979 was valued at $1.2 billion. Massive increases occurred in the values of produced portland cement, clays, lime, copper, lead, silver, zinc, and usable iron ore. The total value of nonfuel mineral production in 1978 was split about equally between metals and nonmetals. Metals were dominant in 1979.

Output of all metals increased in 1979. Clays were the only nonmetal enjoying increased output. Cement, lime, sand and gravel, and stone, all significant construction materials, were produced in reduced quantities, which caused a reduction in the number of stone and sand and gravel producers and operations and gave substance to a recession in construction in 1979. Viburnum No. 27 lead mine of St. Joe Minerals Corp. (St. Joe) was closed because of ore depletion. St. Joe's Pea Ridge iron mine and pellet plant, closed as uneconomic in 1977, was reorganized as Pea Ridge Iron Ore Co., Inc., and reopened in June 1979. Kennecott Copper Corp. announced plans for expanding the Ozark Lead Co. operations on Sweetwater Branch and the development of the new Milliken mine. Strikes shut down mining, milling, and smelting activities at the Buick mine of the AMAX Lead Co. of Missouri in 1978 and at Ozark Lead Co.'s Sweetwater Branch mine in 1979, with resulting curtailment of lead production. Other consequences were inconveniences to Cominco American, Inc., which utilized the Buick smelting facilities, and an interruption of the lead concentrate supply for ASARCO's smelter at Glover. Noranda Aluminum, Inc., shut down its plant at New Madrid for almost 2 months in early 1978 because of a power shortage. Exploration for lead deposits extended southward from the Viburnum trend into parts of Shannon, Carter, Oregon, Ripley, and Butler Counties. Increased prices for cobalt and nickel resulted in renewed testing and development of formerly mined and unmined lead-cobalt-nickel deposits near Fredericktown in Madison County.

Shortages of cement in 1978 influenced the State to bring price-fixing charges against 15 cement firms and join with other States in a similar suit being tried in Federal court in Arizona.

Environmental and regulatory problems affecting mining drew considerable public attention. Alpha Portland Industries, Inc., continued in litigation over a permit to dredge sand and gravel from the Meramec River valley in St. Louis County. The U.S. Forest Service Roadless Area Review and Evaluation (RARE II) was completed. The review involved possible designation of

Table 1.—Nonfuel mineral production in Missouri[1]

Mineral	1977 Quantity	1977 Value (thousands)	1978 Quantity	1978 Value (thousands)	1979 Quantity	1979 Value (thousands)
Barite .... thousand short tons..	117	$4,061	121	$4,661	89	$3,679
Cement:						
Masonry .... do....	82	3,286	89	4,112	82	4,159
Portland .... do....	4,654	155,945	4,733	175,962	4,430	194,285
Clays .... do....	[2]2,373	[2]16,892	[2]2,258	[2]16,880	2,351	20,522
Copper (recoverable content of ores, etc.) metric tons..	10,648	15,681	10,818	15,861	13,021	26,705
Gem stones	--	--	NA	15	NA	10
Gold .... troy ounces..	--	--	--	--	32	10
Lead (recoverable content of ores, etc.) metric tons..	453,824	307,156	461,762	343,070	472,054	547,824
Lime .... thousand short tons..	1,723	51,529	1,791	63,642	1,790	70,187
Sand and gravel .... do....	14,002	31,473	15,560	33,660	12,558	31,310
Silver (recoverable content of ores, etc.) thousand troy ounces..	2,363	10,916	2,056	11,103	2,201	24,410
Stone:						
Crushed .... thousand short tons..	49,612	104,700	57,265	130,568	56,380	139,944
Dimension .... do....	3	597	1	208	(3)	85
Zinc (recoverable content of ores, etc.) metric tons..	74,107	56,203	59,038	40,349	61,682	50,723
Combined value of asphalt (native), clays (fuller's earth, 1977-78), iron ore, and phosphate rock (1977)	XX	67,950	XX	26,373	XX	45,982
Total	XX	826,389	XX	866,464	XX	1,159,835

NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fuller's earth; value included in "Combined value" figure.

[3] Less than 1/2 unit.

Table 2.—Value of nonfuel mineral production in Missouri, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Andrew	W	W	Stone.
Atchison	$1	W	Sand and gravel.
Audrain	[r]3,295	$2,485	Clays.
Barry	445	548	Stone.
Barton	W	W	Stone, asphalt.
Bates	W	W	Stone.
Benton	188	698	Do.
Bollinger	54	40	Sand and gravel.
Boone	W	W	Stone, sand and gravel, clays.
Buchanan	W	W	Stone.
Butler	W	W	Sand and gravel, stone, clays.
Caldwell	509	748	Stone.
Callaway	W	7,043	Stone, clays, sand and gravel.
Camden	308	294	Sand and gravel, stone.
Cape Girardeau	13,869	W	Cement, stone, sand and gravel, clays.
Carter	33	--	
Cass	860	1,212	Stone.
Cedar	W	W	Do.
Chariton	W	W	Stone, sand and gravel.
Christian	W	806	Stone.
Clark	W	W	Stone, sand and gravel.
Clay	W	5,764	Do.
Clinton	W	460	Stone.
Cole	W	W	Stone, sand and gravel.
Cooper	W	W	Do.
Crawford	W	W	Lead, sand and gravel, stone, copper, zinc, clays, silver.
Dade	458	W	Stone.
Dallas	5	W	Stone, sand and gravel.
Daviess	W	W	Do.
De Kalb	W	399	Stone.
Dent	16	W	Do.
Douglas	240	976	Sand and gravel, stone.
Franklin	1,355	1,613	Do.
Gasconade	W	W	Clays, sand and gravel.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Missouri, by county[1] —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Gentry	W	W	Stone, sand and gravel.
Greene	W	W	Lime, stone.
Grundy	W	W	Stone, sand and gravel.
Harrison	W	W	Do.
Henry	W	W	Stone.
Hickory	W	W	Do.
Holt	W	W	Stone.
Howard	W	W	Stone, sand and gravel.
Howell	$695	$997	Sand and gravel, stone.
Iron	W	W	Lead, zinc, iron ore, copper, silver, stone.
Jackson	W	W	Cement, stone, sand and gravel.
Jasper	W	W	Stone, sand and gravel.
Jefferson	W	W	Cement, stone, sand and gravel, clays.
Johnson	492	406	Stone.
Knox	W	W	Do.
Laclede	W	542	Stone, sand and gravel.
LaFayette	W	W	Do.
Lawrence	W	W	Stone.
Lewis	W	W	Sand and gravel, stone.
Lincoln	W	W	Stone, sand and gravel.
Livingston	W	W	Stone, clays, sand and gravel.
McDonald	W	W	Sand and gravel, stone.
Macon	263	263	Sand and gravel.
Madison	W	W	Sand and gravel, stone.
Marion	W	131	Stone, sand and gravel.
Mercer	676	847	Stone.
Miller	W	797	Sand and gravel, stone.
Moniteau	240	W	Stone.
Monroe	W	W	Stone, clays.
Montgomery	W	W	Clays, stone, sand and gravel.
Morgan	154	123	Stone.
Newton	549	506	Stone, sand and gravel.
Nodaway	W	W	Do.
Oregon	W	W	Sand and gravel, stone.
Osage	W	W	Clays, stone, sand and gravel.
Ozark	W	W	Sand and gravel.
Pemiscot	243	297	Do.
Perry	W	W	Stone, sand and gravel.
Pettis	W	W	Stone.
Phelps	W	1,046	Stone, sand and gravel.
Pike	W	W	Cement, stone, clays, sand and gravel.
Platte	W	W	Stone, clays.
Polk	216	217	Stone.
Pulaski	808	1,055	Stone, sand and gravel.
Putnam	W	W	Stone.
Ralls	W	W	Cement, stone, clays.
Randolph	556	W	Stone.
Ray	1,237	1,298	Sand and gravel, stone.
Reynolds	W	163,554	Lead, zinc, copper, silver, sand and gravel.
Ripley	249	306	Sand and gravel.
St. Charles	W	W	Stone, sand and gravel, clays.
St. Clair	W	W	Stone.
St. Francois	W	W	Lime, stone, sand and gravel.
St. Louis	W	W	Cement, stone, sand and gravel, clays.
St. Louis City	W	711	Sand and gravel.
Ste. Genevieve	W	W	Lime, stone, sand and gravel.
Saline	1,339	2,176	Stone.
Scotland	W	W	Do.
Scott	W	W	Stone, clays, sand and gravel.
Shannon	202	384	Stone.
Shelby	W	809	Do.
Stoddard	1,288	1,121	Sand and gravel.
Stone	W	W	Stone.
Sullivan	--	286	Do.
Taney	W	W	Sand and gravel, stone.
Texas	187	285	Stone, sand and gravel.
Vernon	1,421	1,132	Stone.
Warren	W	W	Clays, stone.
Washington	85,608	47,426	Lead, iron ore, barite, copper, zinc, silver, sand and gravel.
Wayne	2,580	3,219	Stone.
Webster	80	W	Stone, sand and gravel.
Worth	W	489	Stone.
Wright	W	W	Do.
Undistributed[2]	705,673	612,954	
Total[3]	826,389	866,464	

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] The following counties are not listed because no nonfuel mineral production was reported: Adair, Carroll, Dunklin, Linn, Maries, Mississippi, New Madrid, and Schuyler.

[2] Includes value of stone and gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Missouri business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force . . . thousands	2,228.0	2,256.0	2,293.0	+1.6
Unemployment . . . do	131.0	114.0	104.0	-8.8
Employment (nonagricultural):				
Mining[1] . . . do	8.4	7.6	8.0	+5.3
Manufacturing . . . do	439.6	456.8	459.7	+.6
Contract construction . . . do	77.8	87.3	92.0	+5.4
Transportation and public utilities . . . do	129.7	136.3	142.4	+4.5
Wholesale and retail trade . . . do	446.1	465.8	475.4	+2.1
Finance, insurance, real estate . . . do	98.0	103.7	108.2	+4.3
Services . . . do	340.7	360.0	378.0	+5.0
Government . . . do	321.5	335.6	339.2	+1.1
Total nonagricultural employment[1] . . . do	1,861.8	1,953.1	2,002.9	+2.5
Personal income:				
Total . . . millions	$31,726	$35,413	$39,581	+11.8
Per capita	$6,579	$7,287	$8,132	+11.6
Construction activity:				
Number of private and public residential units authorized	28,081	[2]29,065	19,509	-32.9
Value of nonresidential construction . . . millions	$423.3	$486.5	$512.1	+5.3
Value of State road contract awards . . . do	$240.0	$160.0	$281.0	+75.6
Shipments of portland and masonry cement to and within the State . . . thousand short tons	1,835	2,153	1,914	-11.1
Nonfuel mineral production value:				
Total crude mineral value . . . millions	$826.4	$866.5	$1,159.8	+33.8
Value per capita, resident population	$171	$178	$238	+33.7
Value per square mile	$11,859	$12,434	$16,644	+33.8

[p] Preliminary.
[1] Includes bituminous coal and oil and gas extraction.
[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

75,000 acres of potential mineral lands in the Mark Twain National Forest as Wilderness and made them inaccessible for prospecting during the review process. The Environmental Protection Agency (EPA) promulgated national standards for lead in the atmosphere and at plant boundaries, and the Occupational Safety and Health Administration (OSHA) proposed standards for occupational exposure to lead in the atmosphere at a workplace. Members of industry, the Governor, and State senators opposed the standards. The economics of solving air and water pollution problems in addition to market problems at National Lead Industries' titanium pigment plant in St. Louis caused the firm to abandon that plant. A lawsuit over pollution of Big River by Dresser Industries remained in litigation. Efforts continued to abate an erosion problem on lead mine tailings and resulting siltation in Big River in St. Francois County. Carthage experienced another collapse of an abandoned mine shaft and a 90-foot-deep hole appeared in the middle of a street. Fifteen dams were declared unsafe in a survey by the U.S. Army Corps of Engineers. One retained a lake on property of Anschutz Corp., Inc., near Fredericktown.

Legislation and Government Programs.—The Legislature gave the State powers through House Bill 932 (1978) to administer an interim program of surface mine reclamation required under Public Law 95-87, the Surface Mining Control and Reclamation Act of 1977. By passing House Bill 459 (1979), the Legislature separated reclamation requirements for coal from those for barite and tar sands as provided in previous legislation. The State gained control over safety of dams and over erosion processes when House Bill 603 was passed in 1979.

The Division of Geology and Land Survey (Missouri Department of Natural Resources) was engaged in field studies of the State's limestone and shale resources and the distribution, petrology, petrography, and geochemistry of buried Precambrian igneous and mineralized rocks of southeast Missouri. An inventory of lands affected by mining interfaced with the State's land reclamation program and provided data cooperatively for the Bureau of Mines Mineral Industry Location System (MILS). Con-

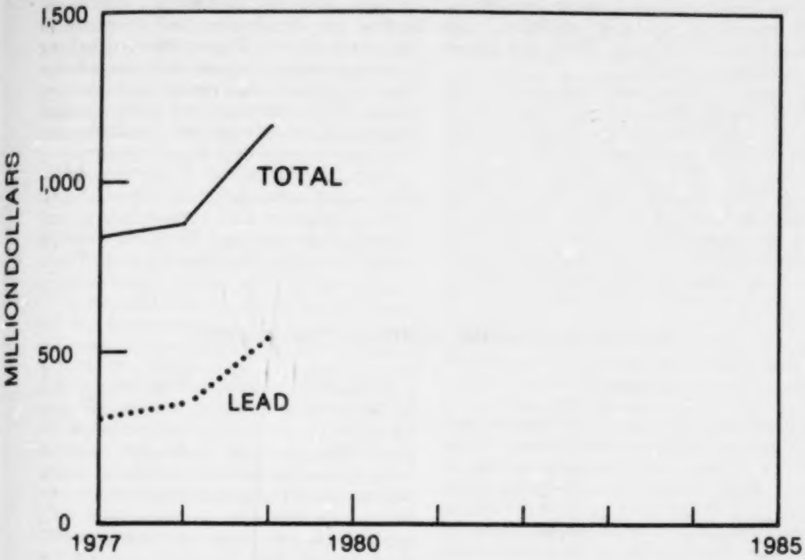

Figure 1.—Value of lead and total value of nonfuel mineral production in Missouri.

siderable effort was expended on review and comment on the RARE II process as it applies to the Mark Twain National Forest, and to wilderness issues in other areas of potential mineral development. Geologic framework studies continued for the U.S. Geological Survey's CUSMAP program in the Rolla 2° quadrangle project and of the seismicity in the New Madrid seismic area for the Nuclear Regulatory Commission. Among the Division of Geology and Land Survey publications on minerals and geology during 1978-79 were a new Geologic Map of Missouri, Geologic Map of the Precambrian of Missouri, and a history of the diaspore industry in Missouri. Results of the Division's efforts in support of the study of the Rolla 2° quadrangle were published largely by the U.S. Geological Survey.

Metallurgical, resource, and other research in minerals was pursued at the Bureau of Mines Rolla Research Center. Among the events significant to the mineral industry in Missouri was publication of results of Bureau of Mines research on cobalt and nickel recovery from chalcopyrite concentrates and their application in a large-scale demonstration at Cominco American's Magmont mill.[2] The research and demonstration were oriented toward recovery of cobalt and nickel from chalcopyrite ores such as those associated with lead deposits near Fredericktown. Research was also supported through contracts, grants, and cooperative projects in academic, State, commercial, and industrial research organizations. State agencies involved were the University of Missouri at Columbia and at Rolla, and the State Division of Geology and Land Survey. Research at the University included problems in electrolytic metal processing, rock-bolt applications, and regional studies of mineral resources. The Division of Geology collected data on all mine sites for entry into the Bureau's MILS system, and provided clay samples for testing by the Bureau. Other research for the Bureau by private organizations treated environmental problems of mining such as handling overburden in strip mining, preventing or inhibiting formation of acid on emergence of waters draining from underground mines, and backfilling techniques. Mine health and safety research was directed toward alleviating industrial-type hazards, preventing and controlling fire and explosions, and stabilizing insecure roofs, floors, and pillars in underground mines.

Mineral problems were addressed in the U.S. Geological Survey-Missouri Division of Geology and Land Survey cooperative geologic mineral assessment of the Rolla 2° quadrangle. The study area comprised about 7,500 square miles that includes mined and unmined resources of lead, zinc, iron, and barite, both outside of and within parts of the Mark Twain National Forest. Resulting maps and reports were published or held as open-file reports. Reports described the distribution and character of exposed and buried Precambrian rocks, configuration, thickness, and facies of selected Cambrian strata, and results and interpretations of the chemical and spectrographic analyses of whole rock and insoluble residues from selected drill holes in the area.

During the period, the University of Missouri at Rolla was designated by the Secretary of the Interior as a State Mining and Mineral Resources and Research Institute pursuant to Title III of Public Law 95-87.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Aluminum.—Aluminum production was curtailed at the Noranda Aluminum, Inc., smelter in New Madrid because of a shortage of electric power from February 14 to April 7, 1978. Excessive cost of substitute power instigated a complete shutdown of the plant. Reactivation of the plant to full capacity required about 40 days. Aluminum recycling activities were enlarged by the opening of a Coor's "Cash-For-Cans" recycling center in Fenton, Mo., in August 1979. Reynolds Aluminum Recycling Co. announced plans to build a new recycling center in South St. Louis to be opened early in 1980.

Copper.—Copper minerals in the Missouri lead ores provide a significant increment of coproduct copper recovered both as concentrates and in the smelting process, and the historical pattern of copper production is roughly parallel to that of lead. Copper output was high in 1975, fell in 1976, rose slowly in 1977-78, and was followed by a rapid rise in 1979. Value of the output followed a similar pattern, with annual average unit prices of copper ranging from about 64 cents to about 70 cents per pound until 1979 when the average price rose to 93 cents per pound. Coincidentally with the increase in price in 1979, output of copper increased by more than 20% over the output in 1978, and the lead-to-copper ratio, which is normally highly variable, fell from an annual weighted average of 42.7:1 for Missouri production in 1978 to 36.3:1 in 1979. The individual ratios in ore from all of the mines except one fell at the same time.

Iron Ore.—Pilot Knob Pellet Co. remained the only producer of iron in Missouri in 1978. Consequently, the output of usable iron ore, which had been decreasing annually from about 2.3 million long tons in 1975, fell to less than 1 million tons in 1978, and the value fell similarly. Reactivation of the Pea Ridge operation by St. Joe Minerals Corp. as the Pea Ridge Iron Ore Co. in the summer of 1979 boosted Missouri ore production for that year by more than 60%, and the value of the ore by more than 84% above that of 1978. The average unit value of the ore rose from about $31.50 per ton in 1975 to almost $35.50 per ton in 1978. Improving world markets in 1979 boosted the unit value to more than $40 per ton in 1979.

Pea Ridge Iron Ore Co. was brought into production in stages. Its products are blast-furnace and direct-reduction grade pellets, speciality products for use in magnetic ferrites, printing inks, brake linings, and the heavy-media material made of magnetite for use in washing coal. Proven reserves of ore were reported to be 100 million tons, or enough for about 30 years operation of the mine.

Lead.—Output of lead in the Nation's leading lead-producing State was on an upward trend in 1978-79. Low production in 1977 was the bottom of a decline from record high production in 1974. Despite production of more than 472,000 metric tons of lead, the output in 1979 was 7.4% below that achieved in 1974. The value of the lead in 1975 fell below that in 1974, but subsequently rose to a record high in 1979 in conjunction with the rise of the unit value of lead from about 21 cents per pound in 1975 to almost 53 cents per pound in 1979. The sharp rise in unit value from 1977 to 1979 accompanied increased consumption, decreased imports of lead from foreign countries, and general shortages of lead in the world market.

Mining took place in Crawford, Iron, Reynolds, and Washington Counties in 1978, and in the latter three in 1979. AMAX Lead Co. of Missouri, Cominco American, Inc., St. Joe Minerals Corp., and Ozark Lead Co. were engaged in mining. St. Joe's active mines in 1978-79 included Viburnum No. 28 in Iron County, Brushy Creek and Fletcher in Reynolds County, and Indian Creek and Viburnum No. 29 in Washington County. Viburnum No. 27 in Crawford County was abandoned in 1978. AMAX operated the Buick mine and Cominco the Magmont mine in Iron County both years. The Ozark or Sweetwater Branch mine of Ozark Lead Co. in Reynolds County operated both years, but was incorporated in the expansion and renamed Milliken Mine and Mill complex in 1979. The Missouri Department of Labor and Industrial Relations reported that these operations employed 1,520 people in mining in 1979. Production was the greatest in Iron County both years, and St. Joe's combined production exceeded all others. Buick mine had the largest individual output.

Two mines suffered major strikes during the biennium. Contracts of the United Steel Workers of America at the Buick mine and mill complex of the AMAX Lead Co. of Missouri and Homestake Mining Co. expired in late May, and workers were on strike from May 31 to August 9, 1978. The workers returned on August 10 after agreeing to settlement involving wages, cost of living, and premium pay adjustments. Half of the capacity at the Buick smelter was dedicated to processing concentrates from the Cominco American Magmont mine and mill. Cominco adjusted by sending out one-third of its concentrates to Bunker Hill and stockpiling the remainder. Output from the Buick mine apparently suffered as its lead production in 1979 rose approximately 17% above production in the strike year. A similar strike over new contract provisions occurred at Ozark Lead Co.'s Sweetwater Branch from March 1 to June 4, 1979. Estimated losses in production were 28,000 to 30,000 tons of concentrates as the recoverable lead in ores from the mine in 1979 decreased more than 20% from output in the previous year. Interruption of the supply of lead concentrates from the Sweetwater Branch to ASARCO's smelter at Glover prevented ASARCO from making full delivery of committed lead and caused the firm to declare a force majeure on its commitments for delivery for several months in the spring and early summer of 1979.

Viburnum No. 27 mine, which had been opened in 1960 by St. Joe, was closed in 1978 because of depletion of the ore supply. The firm's Indian Creek mill in Washington County was shut down in October 1978, and reopened late in the winter in 1979, after repairs had been made. Renewed vigor was given to the Ozark Lead Co. when Kennecott Copper Corp. announced plans to expand the existing plant at Sweetwater Branch and to add a new mine. The facility, renamed the Frank R. Milliken mine, was dedicated in August 1979. The firm planned to increase output of concentrates by 28,000 short tons per year, raising the plant's capability to 96,000 tons per year. Mine output would be increased 33% above the existing yearly capacity of 1,500,000 tons of crude ore, and the work force was expected to increase 25% on completion in the early 1980's. Plans called for adding two shafts, excavating 2 miles of underground tunnel from the existing mine to the site of the new mine, adding new hoisting facilities with a capacity of 2,500 tons per day in an existing air shaft, building a surface belt conveyor from the shaft to the concentrator 2,900 feet away, and enlarging crushing and concentrating facilities. The project was expected to cost $25 million. The firm considered ore reserves in the Milliken mine grading 5% to 6% lead and 1% zinc to be sufficient for 25 to 30 years mining at the expected rate.

Silver.—Missouri was fifth among the States in production of silver in 1979, when 2,201,112 troy ounces of silver were recovered in the smelting of Missouri lead concentrates. After an irregular decline in the output of silver from 1975 through 1978, production increased slightly in 1979. The value of the silver, likewise falling from the value in 1975, turned upward in 1978 and escalated rapidly in 1979 as the average annual unit prices increased from $5.40 per troy ounce to $11.09 per troy ounce. Buick mine in Iron County produced the most silver.

Zinc.—Although zinc is a coproduct of mining and milling lead ores, Missouri's output was exceeded nationally only by that in Tennessee in 1979. Output in 1978, the lowest in the 5-year period 1975-79, also generated the lowest value in any year during that period. Both production and value of zinc increased in 1979. The relatively depressed production during the biennium accompanied the low unit value of zinc, about 31 cents per pound in 1978 increasing to 37 cents per pound in 1979.

Iron County and the Buick mine were the leading sources of zinc.

Other Metals.—A rapid increase of the price of cobalt from about $6.40 per pound in February 1978, to about $25 per pound in March 1979, created new interest in reopening the Madison mine near Fredericktown. The mine is in lead-rich ores that have associated nickel, cobalt, and iron-nickel sulfides. It was last operated by National Lead Co. from 1954 to 1961 to provide cobalt for government stockpiles. Anschutz Corp. purchased the former National Lead Co. properties from Nedlog Technology Group of Arvada, Colo., in March 1979, with the intention of testing the feasibility of recovering cobalt from tailings and from ore in the mine. The firm, which expected that research would identify proper ore treatment procedures, envisioned an output of 1.5 to 2 million pounds per year of cobalt. Research in extraction technology and evaluation of the ore body continued through 1979.

Table 4.—Tenor of lead ore milled and concentrates produced in Missouri

		1978	1979
Total material	metric tons	7,962,153	8,262,993
Metal content of ore:[1]			
Copper	percent	0.15	0.17
Lead	do	6.00	5.90
Zinc	do	0.84	0.85
Concentrates produced and average content:			
Copper	metric tons	20,410	28,066
Recovery ratio	percent	0.26	0.34
Average copper content	do	26.39	27.47
Lead	metric tons	643,086	652,970
Recovery ratio	percent	8.08	7.90
Average lead content	do	73.80	78.99
Zinc	metric tons	107,394	113,189
Recovery ratio	percent	1.35	1.37
Average zinc content	do	58.57	57.52

[1] Figures represent metal content of crude ore only as contained in the concentrate.

Table 5.—Production and value of lead in Missouri and the United States

Year	Missouri			United States	
	Quantity (metric tons)	Value (thousands)	Percent of U.S. production	Quantity (metric tons)	Value (thousands)
1975	468,069	$221,862	83.0	563,783	$267,230
1976	454,492	231,458	82.2	552,971	281,610
1977	453,824	307,156	84.4	537,499	363,789
1978	461,762	343,070	87.2	529,662	393,516
1979	472,054	547,824	89.8	525,569	609,929

Table 6.—Missouri: Mine production (recoverable) of gold, silver, copper, lead, and zinc

		1977	1978	1979
Mines producing: Lode		9	9	8
Material sold or treated: Lead ore	thousand metric tons	8,097	7,962	8,263
Production:				
Quantity:				
Gold	troy ounces	--	--	32
Silver	do	2,362,752	2,056,053	2,201,112
Copper	metric tons	10,648	10,818	13,021
Lead	do	453,824	461,762	472,054
Zinc	do	74,107	59,038	61,682
Value:				
Gold	thousands	--	--	$10
Silver	do	$10,916	$11,103	$24,410
Copper	do	$15,681	$15,861	$26,705
Lead	do	$307,156	$343,070	$547,824
Zinc	do	$56,203	$40,349	$50,723
Total[1]	do	$389,956	[1]$410,382	$649,672

[1] Data do not add to total shown because of independent rounding.

NONMETALS

Barite.—A slight upturn in the amount of barite produced in 1978 interrupted a 6-year sequence of decreasing production. However, the decline resumed in 1979, when the output was almost 32,000 tons less than in 1978, and about 48% below that of 1975. The maximum value of output between 1975 and 1979 was attained in 1978 in conjunction with increased production. However, as with production in 1979, the value of the product that year fell to the lowest level of the 5-year period. These losses in value occurred despite an increase of the average unit price of barite from about $23.30 per ton in 1975 to approximately $41.30 per ton in 1979. The downward trend in both quantity and value contradicted the general high demand for barite in the oil- and gas-drilling industries. Apparently, gradual depletion of Missouri's barite deposits, the generally limited mining and milling facilities, and crowding of the barite industry by expanding urbanization contributed to the fall in production.

Primary barite was produced in Missouri in 1978 by six firms from nine mines in Washington County. Leading producers in 1978 were Dresser Industries of Potosi, NL Industries with production from the Cadet mine and the Big Four mine, and Milchem Co., Keys Branch. Dresser Industries produced run-of-mine barite amounting to more than 25% of the State's total output. The other concerns produced beneficiated materials. Imco Services, a division of Halliburton Co., fostered hope for a possible increase in production of Missouri barite by preparing ground for the construction of a new barite-washing plant east of Mineral Point. The planned capacity of the plant, including a circuit for recovering fine barite, was approximately twice that of the average plant in the barite district. Imco intended to open previously untouched barite resources. Galveston-Houston Co. purchased barite properties owned by Pfizer, Inc., and by Thompson and Agers, on which to construct a new barite-washing mill. The new firm was to operate under the name of Desoto Mining Co. Much of the product was destined for the oil- and gas-drilling industry through Gulfcoast Pre-Mix Mud Services, another Galveston-Houston enterprise. At yearend, Milchem Co. stopped mining barite but maintained operations at its grinding mill.

Cement.—Manufacture of cement generated the largest value among nonmetallic, nonfuel minerals produced in Missouri in 1978-79. Output in 1978, which was the highest in any year between 1975 and 1979, declined somewhat in 1979. Maximum value of the product, more than $198 million and about $80 million greater than in 1975, was attained in 1979. The growth in value and output of cement was related to a boom in housing and nonresidential and highway construction that extended into 1978 when the value of nonresidential construction in Missouri was $486.5 million or 14.9% higher than in the previous year. Slackening of the boom, however, was indicated in 1978 by a 2.9% reduction in the number of private and public residential units authorized for construction from the number authorized in 1977. More strikingly, the value of State road contract awards during 1978 was 33.3% less than in 1977. These conditions presaged a decrease in demand for cement in Missouri and other Midwestern and North-central States in 1979.

Cement was manufactured by six firms in the 1978-79 biennium. Individual plants were located at Independence in Jackson County adjacent to the Missouri River, and at Hannibal in Marion County, Clarksville in Pike County, Festus in Jefferson County, Cape Girardeau in Cape Girardeau County, and St. Louis on the Mississippi River. One firm in St. Louis County was landlocked. The industry's five wet-process plants and two dry-process plants utilized eight wet-process kilns and four dry-process kilns that were equipped with three glass-bag dust collectors and 12 electrostatic precipitators for air pollution control. Four of the plants consumed a total of 2.4 billion cubic feet of natural gas in 1979. About 57,000 barrels of oil and 950,000 tons of coal were also utilized. The electric energy requirements of the seven plants were more than 580 million kilowatt-hours in 1979. Consumption of raw materials required for the manufacture of cement in 1978 included about 6.3 million tons of cement rock and limestone; 1.1 million tons of clay and shale for argillaceous material; sandstone and sand for silicious material; almost 5,000 tons of iron ore, plus mill scale for ferriferous material; and almost 228,000 tons of gypsum. Clinker, fly ash, and slag were also used. Products were gray portland cements, including general-purpose moderate-heat, high-early-strength, and portland pozzolan cements. A very small amount of white portland cement was manufactured. The industry also shipped about 89,000 tons of prepared masonry cement. Portland cement was shipped to users in the following proportions in 1978: ready-mix companies, 77.5%; concrete products manufacturers, 9.5%; highway contractors, 8.4%; building materials dealers, 2.8%; other contractors, 1.8%; miscellaneous users, 0.1%; and government agencies, 0.01%. Distribution in 1979 was approximately the same except for a slight increase in the amount shipped to concrete products manufacturers and a small decrease in the amount shipped to highway contractors. About 85% of the cement shipped from plants to terminals was made in bulk by barge on the Missouri and Mississippi Rivers. Conversely, about 95% of the shipments of portland cement to consumers during the biennium was transported by truck. Rail shipments comprised approximately 5%, and barge shipments to consumers were insignificant.

Gulf & Western's Marquette Co. undertook construction of a new 1-million-ton-per-year cement plant on its Cape Girardeau property. The firm planned to complete this new plant early in 1980. The new system would contain redesigned quarry operations, a primary crusher in the quarry, an enclosed conveyor system to the storage bins, a continuous-blending system, a reinforced suspension preheater of Japanese design, a new grate-type cooler, clinker storage bins, a finishing mill with special mill-discharge dust collectors, and a Raymond coal mill and system to deliver coal both to the discharge end of the kiln and to a calciner in the preheater tower. The cost of the expansion was estimated to be $78 million. In 1979, the River Cement Co. plant at Festus was sold by Missouri Pacific Corp. to IFI International, S.A., of Italy for a price of $78 million.

Shortages of cement and accompanying high prices that appeared in 1978 during a period of maximum production in Missouri were blamed on price fixing and restraint of competition among the manufacturers. Allegedly, customers and territories were allocated to certain companies for the sale of cement, and customers were classified according to eligibility to buy cement. A suit was filed in Federal court in Jefferson City charging such restraint of trade and naming 15 corporations as participants. Alpha Portland Industries, Inc., Dundee Cement Co., Marquette Cement Co., Missouri Portland Cement Co., River Cement Co., and the United States Steel Corp., all producers in Missouri, were among those charged. The Missouri case was transferred along with similar suits from other States to Federal court in Arizona. In August 1979, River Cement Co. of St. Louis agreed to make payments in settlement of the antitrust charges.

Table 7.—Missouri: Portland cement salient statistics

(Short tons)

	1978	1979
Number of active plants	7	7
Production	4,620,003	4,367,519
Shipments from mills:		
Quantity	4,733,117	4,430,370
Value	$175,961,822	$194,284,865
Stocks at mills, Dec. 31	315,701	374,573

Table 8.—Missouri: Masonry cement salient statistics

(Short tons)

	1978	1979
Number of active plants	4	4
Production	83,469	83,042
Shipments from mills:		
Quantity	89,328	81,987
Value	$4,111,611	$4,158,852
Stocks at mills, Dec. 31	6,589	8,766

Clays.—The clay industry of Missouri, the source of a variety of clay products, experienced a fluctuating but distinct upward trend in production from 1975 to 1979. Output of clay in the latter year was more than 8% above that of 1975 and the second highest recorded in the 5-year period. By contrast, the value of produced clay, rising annually through the same 5-year period except in 1978, reached a record high in 1979 of more than $20.5 million, about 55% above the value in 1975. The average unit value of all clays rose correspondingly from about $6 per ton in 1975 to $8.73 per ton in 1979. Produced clays included common clay and shale, fire clay, kaolin, and fuller's earth. Missouri led all other States in the quantity and value of fire clay produced in 1979, but ranked 9th in output and 10th in value of all clay and shale that year.

In 1978, 28 firms obtained clay from 86 mines. The following year, 26 firms mined at 65 sites. About half of the State's output in both years was achieved by three firms: Dundee Cement Co., Harbison-Walker Refractories, division of Dresser Industries, Inc., and Kaiser Aluminum & Chemical Corp. Clay was mined in 22 counties, most of which are in east-central Missouri. In addition, mining occurred in one county in the north-central part of the State, two counties adjacent to Kansas City, and two counties in the southeast adjacent to the Mississippi River. The leading counties, in order of decreasing output, were Pike (common clay), Gasconade (kaolin and fire clay), Montgomery (fire clay), and Audrain (fire clay). Their combined output in 1979 exceeded 55% of the State's total clay production. Common clay and shale were also produced in Boone, Butler, Cape Girardeau, Crawford, Jackson, Jefferson, Livingston, Platte, Ralls, and St. Louis Counties. Fire clay was also mined in Callaway, Franklin, Maries, Monroe, Montgomery, Osage, St. Charles, and Warren Counties. Fuller's earth was mined in Scott County in 1978. About 63% of all the clay mined was common clay and shale, 34% was fire clay and kaolin, and fuller's earth made up the remainder. Fire clay provided approximately 73% of the value of the clay produced in Missouri, followed by 22% from common clay and shale; the remainder came from kaolin and fuller's earth. Fire clay had an average unit value of about $19 per ton in 1979. The unit values of kaolin and common clay and shale were about $17.83 and $2.91 per ton, respectively. Fuller's earth produced in 1978 had a unit value of about $45 per ton. About 75% of the fire clay was used in the manufacture of fire brick, blocks, and shapes. High-aluminum refractories; refractory grogs; refractory mortar and cement; and medical, pharmaceutical, and cosmetic items were other manufactures from fire clay. Aluminum sulfate (alum) was manufactured from kaolin. Face brick and common brick, portland cement, lightweight aggregate for concrete block, and flower pots were manufactured from common clay and shale. Fuller's earth was used in the preparation of oil and grease absorbents and in pesticide carriers and related products. The manufacture of portland cement utilized about 74% of common clay and shale.

Table 9.—Missouri: Clays sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Year	Fire clay		Common clay		Other clays		Total	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1975	854	11,285	1,209	1,928	[1]105	W	2,063	[2]13,214
1976	809	11,723	1,256	2,124	[1]68	[1]1,068	2,133	14,915
1977	872	12,529	1,432	3,190	[1]69	[1]1,173	2,373	16,892
1978	773	12,190	1,434	3,817	[1]51	[1]873	2,258	16,880
1979	799	15,194	1,497	4,350	[1]55	[1]978	2,351	20,522

W Withheld to avoid disclosing company proprietary data; excluded from total.

[1] Kaolin.

[2] Data do not add to total shown because of independent rounding.

Lime.—Led by output from the Ste. Genevieve plant of Mississippi Lime Co., the Nation's most productive such plant in 1979, Missouri's lime production ranked third in the Nation. Output of lime had increased annually from 1975 through 1978, but declined slightly in 1979 to a level about 11.5% greater than in 1975. Annual increases of value in 4 successive years brought the value of produced lime in 1979 to about 73% above the 1975 value. Annual average unit value of lime also increased from about $23.30 per short ton in 1975 to $39.21 per short ton in 1979. About 79% of the product and 73% of the product value was quicklime; the remainder was hydrated lime. Valley Mineral Products Corp. at Bonne Terre produced dolomitic quicklime and refractory dolomite; Ash Grove Cement Co. at Springfield and Mississippi Lime Co. at Ste. Genevieve prepared high-calcium lime. Total shipments of lime from all sources to consumers in Missouri were 229,000 tons in 1978 and 223,000 tons in 1979. The principal uses of lime were in steel manufacturing, in water treatment, and for manufacture of chemicals.

Perlite.—J. J. Brouk & Co. in St. Louis and Georgia Pacific Corp. in Cuba expanded perlite in 1979. Production remained essentially unchanged during the 2 years, but the value of the perlite increased as a result of a rise of almost 15% in unit value. The expanded perlite was used in the preparation of plaster and concrete, for low-temperature insulation and cavity fill, as a horticultural aggregate, fillers, and other uses. Preparation of construction aggregate was the largest single use.

Phosphate Rock.—With the abandonment of mining by Meramec Mining Co. at Pea Ridge, production of apatite concentrates, along with that of iron ore pellets, ceased.

Sand and Gravel.—Sand and gravel output experienced a sequence of fluctuations from 1975 to 1979. The largest output, achieved in 1978, was followed in 1979 by the second lowest output of the 5-year period. Production in 1978 was almost 60% higher than production in 1975. Value of output also culminated in 1978 and declined in 1979, but less sharply than the production. Average unit value of all sand and gravel produced rose from about $1.85 per ton in 1975 to $2.49 per ton in 1979. A drop of 33.3% in the value of State road contract awards in 1978 from the value in 1977 foreshadowed a decrease of about 20% in the output of construction sand and gravel in 1979. Output of industrial sand diminished by less than 1% over the same interval. About 94% of the sand and gravel produced in Missouri during the biennium was used in construction. The remainder was industrial sand. The reduction of output of construction materials was reflected in other statistics. Sand and gravel mining occurred in 61 counties in 1978 and 56 in 1979. The number of companies operating decreased from 130 to 96, and the number of deposits utilized decreased from 136 in 1978 to 101 in 1979. Three firms operating in four mines produced industrial sand in both years. Callaway, Clay, Jefferson, Lewis, St. Louis, and Stoddard Counties, each of which had sand and gravel production exceeding 500,000 tons in 1978, led all others, and accounted for 54.1% of the State's total output. In 1979, operations in Clay, Franklin, Jefferson, and St. Louis Counties provided more than 500,000 tons per year and collectively provided 53.7% of the State output. One hundred and seventeen individual deposits, yielding as much as 300,000 tons each, provided about 67% of the State's output in 1978. Ninety-one deposits in the same size category provided about 55% of the State's output in 1979. The remaining sand and gravel in 1978 was produced from nine deposits, one of which exceeded 1 million tons in annual output. In 1979, 10 deposits provided the remaining output, with one exceeding 1 million tons in annual production. Eighty-three deposits having individual production of less than 100,000 tons provided almost 16% of the output in 1978, while 66 deposits in the same size category provided 19% of the output in 1979.

More than 70% of the sand and gravel produced in 1978 was obtained in counties adjacent to the Missouri and Mississippi Rivers because those counties have relatively abundant stream, flood plain, and terrace deposits of sand and gravel and relatively large concentrations of population. Eight of Missouri's 10 major cities are in counties adjacent to the rivers and provide demands for housing, municipal, industrial, and commercial construction utilizing large quantities of sand and gravel. Construction sand and gravel were used in many ways. In 1979, about 71% of the sand and gravel was used in aggregates, almost 14% was used for roadbase, about 10% comprised fill, and 4% for manufacture of concrete products. Other identifiable uses were for plaster and gunite sands, and as an antiskid material on icy highways. Industrial sand was dedicated to various uses in the following manner: glass products, almost 53%; foundry sand, 23%; manufacture of fiberglass, about 7%; and other minor uses such as manufacture of refractories, silicon carbide, scouring cleansers, pottery, porcelain and tile, and as a flux in smelting metals, as abrasive in sand blasting, as a propping material in hydraulic fracturing, and in roofing granules and fillers. Uses for construction and industrial sand and gravel in 1979 were essentially similar. Trucks hauled about 74% of the sand and gravel shipped in 1978. About 4% was shipped by railroad, and 1% went by other means. Almost 21% was used where it was recovered. Shipments in 1979 involved a percentage decrease in the amount of material carried by truck and an increase in the amount of sand and gravel carried by railway, waterway, and other means of transportation.

Holliday Sand and Gravel Co. operated its first full season with a newly installed barge-mounted plant and dredge at its Randolph site in 1978. The dredge and plant can recover 700 tons per hour of lignite-free sand and gravel for transportation to the shore installations.

Table 10.—Missouri: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	6,514	$13,263	$2.04	8,451	$16,314	$1.93	6,949	$15,304	$2.20
Plaster and gunite sands	NA	NA	NA	50	120	2.40	18	52	2.88
Concrete products	904	2,113	2.34	617	1,492	2.42	225	467	2.08
Asphaltic concrete	1,618	3,312	2.05	1,941	3,809	1.96	2,051	4,265	2.08
Roadbase and coverings	2,479	4,006	1.62	2,014	3,327	1.65	1,392	2,353	1.69
Fill	1,402	1,586	1.13	1,433	1,813	1.27	726	1,078	1.48
Snow and ice control	NA	NA	NA	72	144	1.99	108	238	2.22
Railroad ballast	W	W	W	--	--	--	--	--	--
Other uses	81	154	1.90	119	262	2.20	231	445	1.92
Total[1] or average	12,998	24,435	1.88	14,700	27,280	1.86	11,699	24,201	2.07

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Data may not add to totals shown because of independent rounding.

Table 11.—Missouri: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	8,067	$14,941	$1.85	9,737	$17,542	$1.80	7,871	$15,977	$2.03
Gravel	4,931	9,483	1.93	4,961	9,740	1.96	3,828	8,224	2.15
Total[1] or average	12,998	24,435	1.88	14,700	27,280	1.86	11,699	24,201	2.07
Industrial sand	1,004	7,039	7.01	865	6,378	7.37	859	7,109	8.28
Grand total[1] or average	14,002	31,473	2.25	15,560	33,660	2.16	12,558	31,310	2.49

[1] Data may not add to totals shown because of independent rounding.

Stone.—Missouri ranked fifth among the States in the production of crushed stone in both 1978 and 1979. Maximum annual output in the period extending from 1975 through 1979, about 57.3 million tons, was attained in 1978. The maximum value of output in that period, almost $140 million, was attained in 1979. The growth in value of the stone was related to both the increase in production and to an increase in unit value from about $2 per ton in 1975 to almost $2.50 per ton in 1979. The decrease in the output of stone in 1979 from that in 1978 is attributed to slowing construction. During that period, housing starts declined, the value of State road contract awards made in 1978 was more than 33% below the value in 1977, and the quantity of various aggregates, cement, roofing materials, and other stone used in the construction of highways, building, and other structures declined almost 7%. Dimension stone produced amounted to less than 0.01% of 1% of the quantity and 0.2% of the value of the crushed stone.

Limestone was the most extensively used stone for crushing. Granite, marble, and sandstone were also crushed for special purposes. In approximate order of output, St. Louis, Ste. Genevieve, Jackson, Jefferson, Ralls, St. Charles, and Pike Counties were the leading sources of limestone, each with production of more than 2 million tons in one or both years. Output of the leading five counties was about 38% of the State's crushed stone in both 1978 and 1979. Stone was quarried for crushing in 94 counties in 1978 and 93 in 1979, and by 165 and 151 firms, respectively, for those years. Operations involved 277 quarries in 1978 and 257 in 1979. Output of stone from individual quarries ranged widely in size from a few thousand tons to more than 1 million tons. In 1978, 143 quarries individually produced less than 100,000 tons, 255 quarries produced less than 500,000 tons and accounted for 55% of the stone production. Fourteen quarries were in the size range of 500,000 to 900,000 tons, and production from 11 quarries exceeded 900,000 tons. In 1979, with a decrease in the number of operating quarries, 231 operations each with tonnages of less than 500,000, produced 52% of the stone output. Fifteen quarries were in the category 500,000 to 900,000 tons, and 12 quarries exceeded output of 900,000 tons, providing almost 31% of the State output. Each year about half of the State's quarries were in the lowest size category, but produced less than 10% of the stone quarried. Quarrying occurred in all but 21 counties in 1978. The industry was active, however, and produced the largest quantities of stone in the counties along the Mississippi River north and south of St. Louis and in the vicinities of Jefferson City and Columbia, Kansas City, Springfield, and Joplin. Most of the stone was limestone. Granite (felsite) was produced in Wayne County for railroad ballast and in Iron County for roofing granules. Granite was quarried in Iron County as dimension stone for monuments. Marble quarried in Jefferson County was crushed for terrazzo and exposed aggregate. Sandstone for use as industrial sand was mined in St. Louis and St. Charles Counties. It was also mined in Jefferson County for use in the manufacture of cement. Flagstone was quarried in Shannon County. Crushed stone was used for a variety of purposes. Among those uses that required more than 1 million tons per year in 1978 and 1979 were the various construction aggregates and roadstone, amounting to about 63% of the State's total output. Cement consumed almost 10%, and about 7.5% was used as agricultural limestone. Preparation of lime required almost 6%. Riprap and jetty stone and railroad ballast were also significant uses. In 1978, almost 93% of the shipments of stone were made by truck, about 4% went by railroad, and 2% by water. In 1979, about 88% was shipped by truck; railroads and barges combined transported almost 11%; and about 1% was transported by other means.

Table 12.—Missouri: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	3,571	8,342	4,174	10,464	4,401	11,879
Poultry grit and mineral food	56	330	W	W	W	W
Concrete aggregate	[2]6,869	[r]15,209	8,417	20,086	8,658	22,079
Bituminous aggregate	3,748	8,721	4,668	11,407	4,629	13,287
Macadam aggregate	3,405	5,754	4,885	8,135	3,482	6,649
Dense-graded roadbase stone	5,429	[r]12,132	6,039	14,019	7,092	18,263
Surface treatment aggregate	2,727	6,565	3,279	8,839	3,775	12,056
Other construction aggregate and roadstone	7,866	[r]17,702	10,023	25,102	6,790	18,967
Riprap and jetty stone	3,180	5,660	2,917	6,288	4,871	8,725
Railroad ballast	1,408	2,336	1,312	2,651	1,134	2,105
Filter stone	24	49	37	89	47	115
Manufactured fine aggregate (stone sand)	W	W	W	W	131	447
Terrazzo and exposed aggregate	4	216	5	225	5	240
Cement manufacture	6,095	[r]10,469	6,142	11,175	6,120	12,062
Lime manufacture	3,103	5,294	3,200	5,608	3,230	6,116
Dead-burned dolomite	W	86	W	125	W	W
Flux stone	W	394	W	W	W	W
Asphalt filler	76	198	W	W	75	229
Other fillers	52	264	--	--	--	--
Glass manufacture	W	W	445	1,724	W	W
Sulfur removal from stack gases	596	1,310	404	904	W	W
Other uses[3]	1,402	3,671	1,319	3,725	1,941	6,723
Total[4]	49,612	104,700	57,265	130,568	56,380	139,944

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, marble, and sandstone.

[2] Includes manufactured fine aggregate (stone sand).

[3] Includes stone used for mine dusting, whiting, chemicals, roofing granules, unspecified uses, and uses indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

Sulfur.—Sulfur was recovered by Amoco Oil Co. at its Sugar Creek oil refinery in Jackson County. It was also recovered as sulfuric acid in the smelting of lead ores at the smelters of St. Joe Minerals Corp. and AMAX Lead Co. of Missouri at Herculaneum and Boss. Production in 1979 was somewhat less than in 1978. Conversely, the value of the sulfur was higher in 1979.

Vermiculite.—Preparation of concrete aggregate, loose fill and block insulation, packing insulation, horticultural soils, soil conditioning, and soil fertilization were applications of the exfoliated vermiculite produced by J. J. Brouk & Co. and W. R. Grace & Co. in plants in St. Louis. The quantity of exfoliated vermiculite sold or used remained virtually unchanged from 1978 to 1979. The value, however, increased as the unit value of the exfoliated vermiculite increased about 6%. Fireproofing was also a use of the material.

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[1] State mineral specialist, Bureau of Mines, Denver, Colo.

[2] Clifford, R. K., and L. W. Higley, Jr. Cobalt and Nickel Recovery From Missouri Lead Belt Chalcopyrite Concentrates. BuMines RI 8321, 1978, 14 pp.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt, native:			
Bar-Co-Roc Asphalt Co	Box 11 Iantha, MO 64753	Mine	Barton.
Barite:			
Dresser Industries	Box 8 Potosi, MO 63604	Mine and mill	Washington.
General Barite Co	402 South 2d St. Desoto, MO 63020	Mine	Do.
Milchem, Inc	Mineral Point, MO 63660	Mine and mill	Do.
NL Industries, Inc	Box 2808 St. Louis, MO 63111	do	St. Louis and Washington.
Cement:			
Alpha Portland Cement Co.[1,2]	15 South 3d St. Easton, PA 18043	Plant and quarry	St. Louis.
Dundee Cement Co.[1,2]	Box 317 Dundee, MI 48131	do	Pike.
Marquette Cement Manufacturing Co.[1,2]	7751 Carondelet Ave. St. Louis, MO 63105	do	Jackson and St. Louis.
River Cement Co.[2]	Festus, MO 63028	do	Jefferson.
United States Steel Corp.[1,2]	600 Grant St. Pittsburgh, PA 15230	do	Ralls.
Clays:			
Allied Chemical Corp., Industrial Chemicals Div.	Box 517 Owensville, MO 65066	Mine and plant	Gasconade.
Carter-Waters Corp	GPO Box 19676 Kansas City, MO 64141	do	Platte.
Dresser Industries, Inc., Harbison-Walker Refractories Co.	2 Gateway Center Pittsburgh, PA 15222	do	Callaway, Gasconade, Montgomery, Warren.
Kaiser Aluminum & Chemical Corp	Box 499 Mexico, MO 65265	do	Audrain, Callaway, Gasconade, Montgomery, Warren.
Midland Brick & Tile Co	Box 428 Chillicothe, MO 64601	do	Livingston.
United States Gypsum Co., A. P. Green Refractories Co.	Green Boulevard Mexico, MO 65265	do	Audrain and Osage.
Industrial sand:			
Martin Marietta Corp	110 East Main St. Rockton, IL 61072	Plant and pit	Jefferson.
Master Bros. Silica Sand Co	Route 1, Box 204 Pevely, MO 63070	do	Do.
Pennsylvania Glass Sand Corp	Box 187 Berkley Springs, WV 25411	do	St. Charles and St. Louis.
Iron:			
Hanna Mining Co.-National Steel Corp., Pilot Knob Pellet Co.	Box 26 Ironton, MO 63650	Underground mine and plant.	Iron.
St. Joe Minerals Corp., Pea Ridge Iron Ore Co.	Route 4 Sullivan, MO 63080	do	Washington.
Lead:			
AMAX Lead Co. of Missouri & Homestake Mining Co.[3]	Boss, MO 65440	do	Iron.
Cominco American, Inc.[3]	Bixby, MO 65439	do	Do.
Kennecott Copper Corp., Ozark Lead Co.[3]	Sweetwater, MO 63680	do	Reynolds.
St. Joe Minerals Corp., St. Joe Lead Co.[3]	Viburnum, MO 64105	do	Crawford, Iron, Reynolds, Washington.
Lime:			
Ash Grove Cement Co.[2]	1000 Tenmain Center Kansas City, MO 64105	Plant	Greene.
Mississippi Lime Co.[2]	7 Alby St. Alton, IL 62002	do	Ste. Genevieve.
Valley Mineral Products Corp.[2]	902 Syndicate Trust Bldg. St. Louis, MO 63101	do	St. Francois.

See footnotes at end of table.

Table 13.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Perlite, expanded:			
J. J. Brouk & Co	1367 South Kingshighway Blvd. St. Louis, MO 63110	Plant	St. Louis.
Sand and gravel:			
Barnhart, L. Construction Co	Business Route Hwy. 50 East Jefferson City, MO 65101	Pit and plant	Crawford, Franklin, Jefferson.
Callaway County Sand & Gravel Co.	Box 125 Mokane, MO 65059	Dredge	Callaway.
Capitol Sand Co., Inc.	Box 156 Cedar City, MO 65022	Pit and plant	Do.
Davis Street Sand Co	Foot of Davis St. St. Louis, MO 63111	do	St. Louis.
Doss & Harper Stone Co.	Box 274 West Plains, MO 65775	do	Howell.
Eureka Sand & Gravel Co., Inc.	Box 260 Eureka, MO 63025	Dredge and plant	St. Louis.
Green Quarries, Inc	Box 257 Carrollton, MO 64633	Dredge	Ray, Carroll, Chariton.
Holliday Sand & Gravel Co	6811 West 63d St. Overland Park, KS 66202	Pit and plant	Clay.
Keener Gravel Co., Inc	Box 72 Dexter, MO 63841	do	Ripley and Stoddard.
Lemons Gravel Co	106 West Stoddard St. Dexter, MO 63841	do	Stoddard.
Martin Marietta Aggregates	RFD 4, Box 287 Festus, MO 63028	do	Jefferson.
Missouri Gravel Co.	313 16th St. Moline, IL 61265	do	Lewis.
Pennsylvania Glass Sand Corp.	Box 187 Berkley Springs, WV 25411	do	St. Charles and St. Louis.
Riverside Sand & Dredging	5000 Bussen Rd. St. Louis, MO 63129	Dredge	St. Louis.
Sanders & Sons Rock Products Co.	Box 305 Ava, MO 65608	Pit and plant	Douglas.
St. Charles Sand Co	Route 1, Box 252 St. Louis, MO 63129	Dredge and plant	St. Louis.
Stewart Sand & Material Co	3001 East 83d St. Kansas City, MO 64132	do	Jackson.
West Lake Ready Mix Co	Route 1, Box 206 Bridgeton, MO 63044	do	St. Louis.
Winter Bros. Material Co	13098 Gravois Rd. St. Louis, MO 63127	do	Do.
Stone:			
Gordon Bros. Quarries	Box 127 Forest City, MO 64451	Quarries	Andrew, Gentry, Holt.
Griesemer Stone Co	Route 2, Box 52 Springfield, MO 65804	do	Greene, Jasper, Lawrence.
Midwest Precote Co	4th and Randolph Kansas City, MO 64119	do	Clay and Platte.
Missouri Pacific Corp	210 North 13th St. St. Louis, MO 63103	Quarry	Wayne.
Moline Consumers Co	313 16th St. Moline, IL 61265	Quarries	Jefferson, Knox, Lewis, Ralls, St. Louis, Shelby.
St. Charles Quarry Co., Inc	Box 40 St. Charles, MO 63301	do	St. Charles.
Tower Rock Stone Co	Box 69 Columbia, IL 62236	Quarry	Ste. Genevieve.
Fred Weber, Inc	7929 Alabama Ave. St. Louis, MO 63111	Quarries	Jefferson, St. Charles, St. Louis.
West Lake Quarry & Material Co	Route 1, Box 206 Bridgeton, MO 63042	do	Cape Girardeau, Cole, St. Louis, Scott.
Vermiculite, exfoliated:			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 01109	Plant	St. Louis.

[1] Also clays.
[2] Also stone.
[3] Also silver, copper, and zinc.

The Mineral Industry of Montana

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Montana Bureau of Mines and Geology for collecting information on all nonfuel minerals.

By George T. Krempasky[1] and Don C. Lawson[2]

The value of nonfuel mineral production in Montana was $206 million in 1978 and $291 million in 1979. The accumulated value of produced metals — antimony, copper, iron ore, gold, lead, silver, tungsten, and zinc — accounted for 58% of the State's total nonfuel mineral production value in 1978. By comparison, the previous year's accumulated value of produced metals accounted for 63% of the total. In 1979, the value of Montana's metal production increased nearly 58%, compared with that of 1978. The accumulated value of the State's production of nonmetals — barite, cement, clays, fluorspar, gem stones, gypsum, lime, peat, phosphate rock, pumice, sand and gravel, stone, talc, and vermiculite — accounted for 42% of the total nonfuel mineral production value in 1978. During the previous year, the accumulated value of nonmetals production was 37% of the total. In 1979, the value of nonmetal production increased more than 18%, compared with that of 1978.

Compared with the value of other States' production, the value of Montana's production ranked in the top five in 1978-79 for the following commodities: vermiculite, talc, antimony, copper, and silver.

Atlantic Richfield Co. (ARCO) reached a provisional settlement with the U.S. Federal Trade Commission that permitted ARCO to retain the Anaconda Co. The settlement required ARCO to divest itself of some of Anaconda's holdings; these were the Heddleston copper and molybdenum deposit near Lincoln, Mont., the Ann Mason and Bear ore deposits near Yerington, Nev., a 20% interest in Inspiration Copper Co., and a 50% interest in Anamax Mining Co.

During 1979, Anaconda's copper smelter in Anaconda and the copper smelter of ASARCO Inc. in East Helena were shut down for 1 month for lack of feed. Montana's mineral processing plants continue to be dependent upon out-of-State sources for raw materials. The ASARCO smelter received over 90% of its feed from out-of-State, and more than 50% of the feed for the Anaconda Co.'s smelter and refinery at Great Falls came from out-of-State. Anaconda's aluminum plant in Columbia Falls received all of its alumina from outside the State, and the Stauffer Chemical Co.'s phosphate plant in Silver Bow County received all of its phosphate rock from Idaho.

The Montana Department of State Lands issued a hard rock operating permit for ASARCO'S Troy project, an underground copper-silver mine with related ore processing facilities. The mine's life was estimated at 16 years, and ASARCO expected to produce 60,000 short tons of ore concentrates per year from the project. A total of 64 million short tons of ore containing 0.74% copper and 1.54 ounces of silver per ton had been delineated.

Proposed Federal actions related to revising or abolishing the General Mining Act of 1872 have resulted in controversy, as have U.S. Forest Service Roadless Area Review and Evaluation (RARE II) studies, and U.S.

Table 1.—Nonfuel mineral production in Montana[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony short tons	164	$663	W	W	W	W
Barite thousand short tons	10	W	W	W	W	W
Clays do	224	3,557	217	$3,699	424	$11,508
Copper (recoverable content of ores, etc.) metric tons	78,202	115,167	67,326	98,705	69,854	143,268
Gem stones	NA	100	NA	100	NA	100
Gold (recoverable content of ores, etc.) troy ounces	22,348	3,314	19,967	3,865	24,050	7,395
Lead (recoverable content of ores, etc.) metric tons	96	65	132	98	258	299
Lime thousand short tons	223	7,705	204	7,030	216	8,965
Pumice do	5	7	--	--	--	--
Sand and gravel do	4,867	10,421	[2]6,391	[2]14,230	7,012	15,106
Silver (recoverable content of ores, etc.) thousand troy ounces	3,367	15,558	2,918	15,759	3,302	36,618
Stone:						
Crushed thousand short tons	3,680	7,923	3,188	7,733	2,527	7,806
Dimension do	3	114	W	W	W	W
Talc do	226	2,947	319	5,152	343	5,940
Zinc (recoverable content of ores, etc.) metric tons	79	54	79	54	104	86
Combined value of cement, fluorspar (1977), gypsum, iron ore, peat, phosphate rock, sand and gravel (industrial, 1978), tungsten ore, vermiculite, and values indicated by symbol W	XX	45,658	XX	49,375	XX	54,196
Total	XX	213,253	XX	205,800	XX	291,287

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes industrial sand; value included in "Combined value" figure.

Bureau of Land Management wilderness studies. No consensus concerning the proposed Federal actions had surfaced in Montana, despite public reviews and hearings throughout the State. Interest groups, including the Western Environmental Trade Association (WETA), Montana Mining Association (MMA), Montana Coalition for Wilderness (MCW), and the Inland Forest Resource Council (IFRC), have made conflicting evaluations regarding RARE II. WETA and MMA recommended Alternative B, which would allow multiple use; MCW offered Alternative W and was calling for significantly more wilderness and wilderness study areas; and, IFRC was in disagreement with MCW's proposal, but had not decided on its position. Montana's Governor Thomas L. Judge had recommended that 20 of the roadless national forest areas, which contained about 600,000 acres, be designated "instant wildernesses." In addition, the Governor recommended that a new category, "back country," be established for another 12 roadless areas containing about 740,000 acres.

Public hearings relating to Federal actions were conducted throughout the State. Included were a National RARE II Conference; a Senate Committee on Energy and Natural Resources hearing on S.2080, a bill entitled "To Make the Federal Columbia River Power System Available for Maximum Electric Efficiency for Future Essential Power Supply, to Promote Conservation, and for Other Purposes"; 6 public hearings related to land and water uses that were held under the auspices of the Missouri River Basin Commission; and meetings related to the Great Bear and Elkhorn wilderness study areas.

The Montana Legislature convened on January 3, 1979, after not having been in session during 1978. Initiative 80, entitled "To Empower Montana Voters to Approve or Reject any Proposed Nuclear Power Facility Certified Under the Montana Major Facility Citing Act", was passed by Montana voters in November 1978. Under the initiative, an application for the construction of any nuclear power facility would be submitted to the Department of Natural

Table 2.—Value of nonfuel mineral production in Montana, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Beaverhead	$479	$917	Stone, silver, sand and gravel, peat, lead, zinc, gold, copper.
Big Horn	53	53	Sand and gravel, stone.
Broadwater	6	W	Silver, gold, lead, zinc, copper.
Carbon	W	W	Clays, stone, sand and gravel.
Carter	W	W	Clays, stone.
Cascade	W	1,131	Sand and gravel, stone.
Chouteau	162	172	Do.
Custer	W	25	Sand and gravel.
Daniels	11	38	Do.
Dawson	444	694	Do.
Deer Lodge	7,902	6,893	Lime, stone, sand and gravel, tungsten, clays.
Fergus	1,103	1,136	Gypsum, stone, sand and gravel, clays.
Flathead	1,495	2,217	Sand and gravel, stone.
Gallatin	18,120	W	Cement, stone, sand and gravel, clays.
Garfield	2	--	
Glacier	--	7	Stone.
Golden Valley	56	56	Sand and gravel.
Granite	1,773	W	Silver, copper, stone, gold, sand and gravel, lead, zinc.
Hill	30	19	Sand and gravel.
Jefferson	13,825	16,564	Cement, stone, sand and gravel, gold, silver, lead, zinc, copper,clays, tungsten.
Judith Basin	W	W	Gypsum.
Lake	427	W	Sand and gravel, gold, silver, lead, zinc, copper, stone.
Lewis and Clark	181	W	Sand and gravel, stone, gold, lead, silver, zinc, copper.
Liberty	34	46	Sand and gravel.
Lincoln	13,140	W	Vermiculite, stone, sand and gravel.
McCone	--	2	Stone.
Madison	3,119	W	Talc, gold, silver, copper, lead, stone, zinc.
Meagher	W	W	Iron ore, stone, gold.
Mineral	31	81	Stone, sand and gravel.
Missoula	W	W	Sand and gravel, barite, stone.
Musselshell	62	84	Sand and gravel.
Park	W	W	Stone, sand and gravel.
Petroleum	31	11	Sand and gravel, stone.
Pondera	W	W	Sand and gravel.
Powder River	7	--	
Powell	W	W	Phosphate rock, sand and gravel, stone, gold, copper, silver.
Ravalli	W	W	Sand and gravel, stone.
Richland	W	W	Lime, sand and gravel.
Roosevelt	75	--	
Rosebud	W	147	Sand and gravel, stone.
Sanders	709	W	Antimony, stone.
Sheridan	16	W	Sand and gravel.
Silver Bow	W	W	Copper, silver, gold, sand and gravel, stone.
Stillwater	24	15	Sand and gravel.
Sweet Grass	16	17	Sand and gravel, stone.
Teton	174	--	
Toole	100	100	Sand and gravel.
Treasure	704	W	Clays, stone.
Valley	50	W	Sand and gravel, clays, stone.
Yellowstone	W	W	Sand and gravel, lime, clays.
Undistributed[2]	148,890	175,379	
Total[3]	213,253	205,800	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Blaine, Fallon, Phillips, Prairie, Wheatland, Wibaux, and Yellowstone National Park Counties are not listed because no nonfuel mineral production was reported.

[2] Includes gem stones and stone that cannot be assigned to specific counties and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Montana business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	345.0	367.0	370.0	+0.8
Unemployment	do.	22.0	22.0	19.0	-13.6
Employment (nonagricultural):					
Mining[1]	do.	6.1	7.0	7.6	+8.6
Manufacturing	do.	25.1	26.3	26.9	+2.3
Contract construction	do.	15.7	16.7	15.3	-8.4
Transportation and public utilities	do.	20.3	21.7	23.2	+6.9
Wholesale and retail trade	do.	67.0	72.2	74.5	+3.2
Finance, insurance, real estate	do.	11.2	12.2	12.7	+4.1
Services	do.	49.4	52.6	54.7	+4.0
Government	do.	70.0	71.7	70.1	-2.2
Total nonagricultural employment[1]	do.	264.8	280.4	[2]284.9	+1.6
Personal income:					
Total	millions	$4,585	$5,425	$5,826	+7.4
Per capita		$5,988	$6,915	$7,412	+7.2
Construction activity:					
Number of private and public residential units authorized		5,627	[3]4,817	3,028	-37.1
Value of nonresidential construction	millions	$70.5	$95.8	$80.4	-16.1
Value of State road contract awards	do.	$85.0	NA	$105.0	--
Shipments of portland and masonry cement to and within the State	thousand short tons	354	366	339	-7.4
Nonfuel mineral production value:					
Total crude mineral value	millions	$213.3	$205.8	$291.3	+41.5
Value per capita, resident population		$278	$262	$371	+41.6
Value per square mile		$1,449	$1,399	$1,980	+41.5

[p] Preliminary. NA Not available.

[1] Includes bituminous coal and oil and gas extraction.

[2] Data do not add to total shown because of independent rounding.

[3] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Resources where it would be scrutinized under the provisions of the Montana Major Facility Siting Act. If certification is granted by the State agency, the proposed action of the State agency would then be subject to voter approval by a Statewide referendum.

Montana's 1979 legislature enacted laws that may affect the nonfuel mineral industry; they address taxation, mine reclamation, safety, air quality, water appropriations, and utility siting.

As required by law, State agencies responsible for promulgating and administering regulations related to mineral resource recovery, extraction, siting, and processing, conducted hearings throughout the State. The hearings covered air quality, water quality, discharge permits, an environmental impact statement (EIS) on the Troy project, an EIS on a proposed copper-silver mine, a construction permit for Colstrip Units 3 and 4 (700 megawatt coal-fired generating plants), discharge related to solution mining of uranium, water appropriation, and lease applications for minerals on State lands.

During the 1978-79 period, the Secretary of the Interior designated 31 schools and universities throughout the country, including the Montana College of Mineral Science and Technology at Butte, as State Mining and Mineral Resources and Research Institutes, enabling them to share $5.4 million under Title III of Public Law 95-87. This law provides for annual allotments to one designated institute in each participating State through fiscal year 1984 and for research and scholarship grants to those institutes. Under the law, the institutes are to establish training programs in mining and minerals extraction and provide scholarships and fellowships. Each institute initially received a basic grant of $270,000 for scholarships and fellowships.

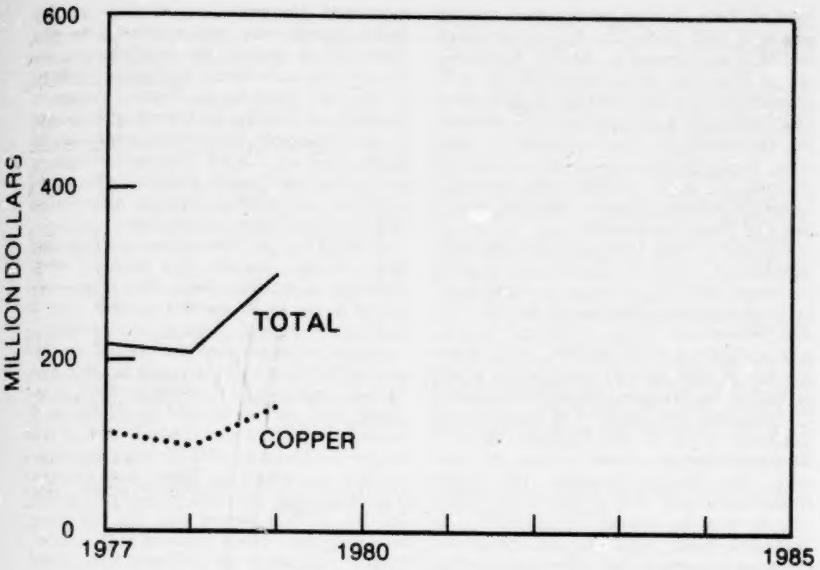

Figure 1.—Value of copper and total value of nonfuel mineral production in Montana.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

The production values of the three principal metal commodities produced in the State — copper, gold, and silver — reflected price increases when compared to the yearly average values of production over a 10-year period (1970-79). The average value of copper production was $131 million for the period. In 1977, the value of copper production was 85% of the average; in 1978, it was 73%; and in 1979, it was 109%. The average value of silver production was $13.9 million. In 1977, the value of silver production was 112% of the average; in 1978, it was 113%; and in 1979, it was 264%. The average value of gold production was $3.0 million. In 1977, the value of gold production was 109% of the average; in 1978, it was 127%; and in 1979, it was 243%. Dramatic price increases in precious metals were reflected in the 1979 production values, and these price increases stimulated dramatic new exploration and development activity in western Montana. However, except for silver in 1977 and gold in 1979, the quantity of production was below the State's 10-year average in 1977, 1978, and 1979.

Reflecting the increase in exploration and development activities, Zortman Mining Co. and Landusky Mining Co. received operating permits for open pit and heap-leach operations in the Little Rocky Mountains. At the Polaris Mine, a relatively good grade silver ore was being mined, and development in virgin ground indicated additional reserves. In the Tobacco Root Mountains, a gold operation was idled because of a labor-management dispute. The heap-leach operation near Boulder, with approximately 35,000 short tons on the pad, was shut down, and no definite plans existed for near-future resumption. A small gold heap-leach plant was in the development stage at the old Atlantic/Pacific Mine in the Tobacco Root Mountains. In the Rochester Basin area, west of Twin Bridges, exploration activity was at a high pitch. The U.S. Grant Mine and Mill were leased to the Delaney brothers of Missoula, who renovated the mill; production increases were noted. John Magnus continued to operate his mill, processing various types of ores, including tungsten, from Beaverhead County. Renewed interest in placer mining was noted in Lewis and Clark, Jefferson, Meagher, Madison, and Missoula Counties.

Precious metals activities were of great significance; however, the impact of price increases was also reflected in exploration and development activities for the complex ores. Nancy Lee Mines, in Mineral County, was stockpiling about 90 short tons of ore per day. It was planned that the ore would be milled by Western Silver Development Co. Congdon and Carey and Superior Oil continued work at the Flathead Mine in Flathead County, where an open pit operation may become feasible. The Nellie Grant Mine and Mill in Lewis and Clark County was the site of major activity on gold-silver base metal ore. Anaconda and Cominco American Inc. (Cominco) continued exploration activities, seeking potential silver and stratabound lead-zinc deposits in Meagher County. In Park County, gold-tungsten-arsenic resources were being investigated, with claim staking, drilling, geophysical surveys, and other activities underway. Stockpiling of shaft-sinking and development ore continued in the Castle Mountains, Meagher County. In Jefferson County, the Crystal and Rumley Mines, potential sources of silver-gold-lead ores, were in the development stage. The Black Pine Mine in Granite County installed an optical ore sorter, and ore grade increased by 40%. Expansion plans at Black Pine were announced by the operating company. Development work continued at the Silver King Mine, also in Granite County.

Exploration in the Stillwater Complex, seeking platinum-palladium ore, continued with the drilling of deeper holes by both Anaconda and Johns-Manville Sales Corp. (Chevron Industries Inc. was in joint venture with Johns-Manville). Anaconda received a permit from the State and began to drive an exploration adit to secure bulk samples of the platinum-palladium horizon for metallurgical testing.

Anaconda completed the first hole in a continuing deep-hole exploration program in the Butte area. Evaluation of a large-volume underground mining method for extracting low-grade copper ores in the Butte district was also continued by the company. A search for molybdenum resources was undertaken by Cyprus Industrial Minerals Corp. in the Pioneer Range in Beaverhead County, by Canadian interests in the Bitterroot Mountains southwest of Darby, and by AMAX Inc. and Molycorp Inc. in Cascade County. Also, tungsten properties in Beaverhead County were being evaluated by Union Carbide Corp.

ASARCO's East Helena lead smelter was down during August 1979 because of a shortage of smelter feed. The plant was forced to reduce its operating week from 7 to 5 days because of a lack of concentrates.

Copper.—Copper was recovered from the ores of 29 mines in 13 counties in 1979, and from 14 mines in 9 counties in 1978, compared with recovery from 13 mines in 7 counties in 1977. Approximately 99% of the copper produced in 1978-79 was from Anaconda's operations in Silver Bow County. Yearly average Montana copper production for the 1970-79 period was 101,219 short tons with an average value of $131 million. Copper production for 1977 was 85% of the average; the value of this production was 88% of the average. In 1978, production was 73% of the average, and value was 75%. The 1979 production was 76% of the average, and its value was 109%. Montana ranked fourth in its 1978-79 copper production value, compared with that of other producing States. It supplied about 5% of the new copper production in the United States for both years.

Anaconda had undertaken an exploration program to determine if minerals of economic significance continue to depth in Butte. According to company officials, their drilling program was designed to penetrate to depths of 8,000 feet. The area that was being drilled has the potential for four to six new underground mines. The first deep hole was completed, and several deep-drill rigs were operating in the area east of the Berkley Pit. Planning continued for a major block-caving operation in Butte. A new viewing stand at the Berkley Pit was dedicated in June, 1978. It provides a closer and somewhat more spectacular view than did previous viewing areas. The company's smelter in Anaconda was shut down for maintenance and repair during portions of May and June, 1978.

Gold.—Gold was recovered principally as a byproduct of copper mining. Approximately 95% of the gold produced in the State in

1977, 85% of that produced in 1978, and 89% of that produced in 1979 was associated with ores from Anaconda's Berkley Pit operation in Butte.

A total of 24 mines produced gold in Montana in 1977; 24 mines, including three placer operations, produced in 1978; and 31 mines, one being a placer mine, produced gold in 1979. Average gold production for the 1970-79 period was 22,512 troy ounces annually, and its average annual value was $3 million. Respectively, production in 1977, 1978, and 1979, was 99%, 87% and 107% of the average. Value received for the commodity for 1977, 1978, and 1979, when related to the average yearly value for the 10-year period, was 109%, 126%, and 243%, respectively. Based on the value of its gold production, Montana ranked seventh in 1978 and sixth in 1979 among the gold-producing States. Approximately 2% of the newly mined gold from U.S. mines in 1978, and 3% in 1979, came from Montana.

A great interest was indicated in the use of heap-leaching for gold recovery. Three companies were conducting research in the areas of Zortman-Landusky, Elkhorn, and the Golden Sunlight. Conventional mills were being erected or retrofitted near Sheridan, Lewistown, Virginia City, Philipsburg, and Basin. Placer activities were underway near White Sulphur Springs, Alder Gulch, Browns Gulch near Virginia City, in the Nine Mile area near Missoula, and in Lewis and Clark County. However, only one property reported production.

Iron.—R & S Iron Co. produced ore for direct shipping to cement manufacturers. Production decreased in 1978, compared with that of 1977, and again in 1979, com-

Table 4.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by class of ore or other source material

Source	Number of mines[1]	Material sold or treated (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
1978							
Lode ore:							
Gold[2]	6	37,368	1,200	640	(3)	1	1
Gold-silver	10	5,113	1,221	48,083	5	64	37
Silver	8	73,472	544	587,726	548	59	38
Total[4]	23	115,953	2,965	636,449	554	124	76
Copper and lead-zinc[5]	2	16,229,267	16,958	2,281,861	64,097	8	3
Total[4]	25	16,345,220	19.923	2,918,310	64,651	132	79
Other lode material:							
Copper precipitates	2	3,867	--	--	2,675	--	--
Total lode material[4]	25	16,349,088	19,923	2,918,310	67,326	132	79
Placer	3	--	44	7	--	--	--
Total[4]	28	16,349,088	19,967	2,918,317	67,326	132	79
1979							
Lode ore:							
Gold and gold-silver[5]	9	3,554	429	12,994	5	47	19
Silver	10	70,812	2,007	567,405	596	31	31
Total[4]	19	74,366	2,436	580,399	601	78	49
Copper, lead, and lead-zinc[5]	13	15,544,915	21,600	2,721,462	62,240	179	55
Total[4]	32	15,619,282	24,036	3,301,861	62,841	257	104
Other lode material:							
Gold tailings	1	5	10	67	(3)	(3)	--
Copper precipitates	2	11,852	--	--	7,013	--	--
Total Lode material[4]	33	15,631,139	24,046	3,301,928	69,854	258	104
Placer	1	--	4	--	--	--	--
Grand total[4]	34	15,631,139	24,050	3,301,928	69,854	258	104

[1] Detail may not add to total because some mines produce more than one class of material.
[2] Includes material that was leached.
[3] Less than 1/2 unit.
[4] Data may not add to totals shown because of independent rounding.
[5] Combined to avoid disclosing company proprietary data.

pared with that of 1978. The value of iron production also decreased for 1978-79, compared with that of 1977.

Silver.—The principal source of silver, accounting for approximately 78% of the State's total output in 1978 and 80% in 1979, was silver that was produced as a byproduct from Anaconda's Berkley Pit in Silver Bow County. In 1978 and 1979, production of silver outside the Butte area amounted to 637,000 and 646,000 troy ounces, respectively. Production in 1979 was from 31 mines in 14 counties; in 1978, silver production was from 25 mines in 9 counties; and in 1977, production was from 29 mines in 12 counties. Montana ranked fourth among the producing States in the production of silver in 1978 and third in 1979. About 7% of the newly mined silver production in the United States during 1978 came from Montana mines; in 1979, Montana's share was approximately 9%.

Table 5.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing		Material sold or treated[1] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1977, total	29	--	14,117,870	22,348	$3,314,430	3,367,442	$15,557,582
1978:							
Beaverhead	1	--	440	10	1,936	20,570	111,078
Granite	6	--	71,701	746	144,388	560,904	3,028,882
Jefferson	5	--	41,365	1,183	228,971	36,240	195,696
Lewis and Clark	4	1	122	47	9,097	1,031	5,566
Madison	5	--	1,833	952	184,259	16,919	91,363
Silver Bow	1	--	11,233,015	16,949	3,280,479	2,281,180	12,318,372
Undistributed[2]	3	2	612	80	15,484	1,473	7,964
Total	25	3	16,349,088	19,967	3,864,614	2,918,317	15,758,911
1979:							
Beaverhead	3	--	746	59	18,143	19,657	217,996
Jefferson	4	--	4,452	319	98,093	21,207	235,185
Lewis and Clark	4	--	541	148	45,511	8,368	92,801
Madison	8	--	755	1,308	402,211	28,130	311,960
Mineral	1	--	10,886	43	13,223	44,166	489,801
Silver Bow	1	--	15,544,651	21,336	6,560,820	2,655,499	29,449,484
Undistributed[3]	12	1	69,108	837	257,380	524,901	5,821,151
Total	33	1	15,631,139	24,050	7,395,381	3,301,928	36,618,378

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1977, total	78,202	$115,167,145	96	$65,031	79	$54,015	$134,158,203
1978:							
Beaverhead	(4)	290	6	4,814	6	3,959	122,077
Granite	534	783,326	4	3,021	4	2,812	3,962,429
Jefferson	18	25,935	104	77,261	60	40,777	568,640
Lewis and Clark	(4)	279	10	7,634	5	3,419	25,995
Madison	32	46,708	2	1,714	2	1,315	325,359
Silver Bow	66,741	97,846,925	--	--	--	--	113,445,776
Undistributed[2]	1	1,249	4	3,181	2	1,508	29,376
Total[5]	67,326	98,704,712	132	97,625	79	53,790	118,479,652
1979:							
Beaverhead	1	1,890	8	8,793	23	18,505	265,327
Jefferson	12	24,749	68	78,461	26	21,521	458,009
Lewis and Clark	2	4,561	131	152,391	50	40,967	336,231
Madison	W	W	2	2,538	1	1,192	[6]717,901
Mineral	10	21,070	34	39,793	--	--	563,887
Silver Bow	69,133	141,789,334	--	--	--	--	177,799,638
Undistributed[3]	696	1,426,484	14	16,814	5	3,927	7,524,526
Total[5]	69,854	143,268,088	258	298,790	104	86,112	187,665,519

W Withheld to avoid disclosing company proprietary data; included in "Undistributed."

[1] Does not include gravel washed.

[2] Broadwater, Lake, Meagher, and Powell Counties are combined to avoid disclosing company proprietary data.

[3] Broadwater, Fergus, Glacier, Granite, Judith Basin, Lake, Ravalli, and Sanders Counties, and items indicated by symbol W combined to avoid disclosing company proprietary data.

[4] Less than 1/2 unit.

[5] Data may not add to totals shown because of independent rounding.

[6] Excludes value of copper content.

Table 6.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
1978					
Lode:					
Cyanidation	822	806	--	--	--
Smelting of concentrates from ore	17,949	2,298,719	64,098	6	4
Total	18,771	2,299,525	64,098	6	4
Direct smelting of:					
Ore	1,152	618,785	552	125	75
Precipitates	--	--	2,675	--	--
Total[1]	1,152	618,785	3,228	125	75
Total lode	19,923	2,918,310	67,326	132	79
Placer	44	7	--	--	--
Grand total	19,967	2,918,317	67,326	132	79
1979					
Lode:					
Amalgamation, cyanidation, and smelting of concentrates from ore[2]	21,613	2,700,625	62,130	37	2
Direct smelting of:					
Ore	2,433	601,303	710	221	103
Precipitates	--	--	7,013	--	--
Total[1]	2,433	601,303	7,724	221	103
Total lode[1]	24,046	3,301,928	69,854	258	104
Placer	4	--	--	--	--
Grand total	24,050	3,301,928	69,854	258	104

[1] Data may not add to totals shown because of independent rounding.
[2] Combined to avoid disclosing company proprietary data.

Table 7.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in Silver Bow County

Year	Mines producing	Material sold or treated (thousand metric tons)	Gold (troy ounces)	Silver (thousand troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)	Total value (thousands)
1975	6	17,499	13,528	2,162	79,766	11	4	$124,647
1976	2	15,244	19,845	2,937	82,471	3	1	141,810
1977	1	14,054	21,181	3,081	77,942	--	--	132,163
1978	1	11,233	16,949	2,281	66,741	--	--	113,446
1979	1	15,545	21,336	2,655	69,133	--	--	177,800
1882-1979	--	[1]500,929	2,654,943	678,674	8,539,048	415,442	2,406,823	5,646,866

[1] Complete data not available for 1882-1904.

The average amount of yearly silver production and its value for the 1970-79 period were 3,372,191 troy ounces and $13.9 million, respectively. In 1977, production and value were 100% and 112% of the average, respectively; and in 1978, the respective percentages were 86% and 113%. The 1979 percentages were 98% and 264% of the 10-year average.

NONMETALS

Production and market demand for Montana nonmetal minerals continued to be steady. The possible development of a potash refining plant and mine complex in northeastern Montana generated much interest. PPG Industries, Inc. and Farmers Potash Co., a Burlington Northern Inc. and Farmers Union Central Exchange (Cenex) joint venture, was considering the area for potash development. The extraction process under consideration would employ solution mining to recover potash from depths to 9,000 feet. American Colloid Co.'s new bentonite processing plant went onstream at Malta in Phillips County. However, proposed plant expansion to 1 million short tons per year was delayed because of market conditions. Lovell Clay Products of Billings purchased Lewistown Clay, Inc. The new owners planned to improve operations over a 5-year period and anticipated an eventual increase in annual capacity from 3 million to 10.5 million units.

Montana Barite Co. continued to mine and process barite for a very strong market. Talc production continued at a relatively high rate, and production of industrial silica continued. Production of limestone, cement, vermiculite, phosphate rock, and other nonmetals was relatively strong.

Barite.—The value and quantity of barite production increased, and a continued demand for the commodity was postulated. However, the availability of reserves remained questionable. Exploration and development had not delineated any significant minable quantity of barite.

Cement.—Two plants, one at Trident and the other at Montana City, produced cement in 1978-79. Portland cement sales in 1978 were about 2% higher than the yearly average for the 1977-79 period. Sales in 1979 were 6% less than the average. The value of cement sales in 1978 was about 1% less and in 1979 was about 7% higher than the yearly average.

Clays.—The State's output of clays and shales was from 16 mines in 9 counties. The material produced was used for animal feed, common brick, face brick, drill mud, fertilizer, glazing, foundry sand, portland cement, waterproofing and sealing, insulation, iron pellets, paper coating and filler, pottery, and concrete blocks. There were 11 individuals and/or companies producing clays. The size of the operations ranged from 15 short tons to about 75,000 short tons per year.

American Colloid's bentonite processing plant near Malta went onstream, with bentonite mined from State and Federal lands south of Malta. The plant was the initial step of a 3-phase construction program. Begun in 1978, phase 1 consisted of construction of the processing plant, a railroad siding, a laboratory, and office facilities. Plant capacity under this phase was estimated to be 250,000 short tons per year. Phase 2 construction was planned to include another siding, grinding equipment, and storage silos; production capabilities were expected to increase to 500,000 short tons per year. The program's phase 3 would include the building of an additional processing plant, more silos, and another railroad siding; production capacity was ultimately expected to increase to 1 million short tons annually. Because of an absence of markets, however, the expansion program was in abeyance.

Lovell Clay Products, the new owners of Lewistown Clay, Inc., planned to improve its newly purchased production facilities. The company's intent was to increase annual production over a 5-year period from 3 million to 10.5 million units.

Gypsum.—Crude gypsum was produced by United States Gypsum Co. in Fergus County for use in wallboard production. The Maronick Construction Co., Judith Basin County, also mined gypsum for use in the manufacture of cement. Exploration and development disclosed additional gypsum resources and reserves.

Lime.—Anaconda, Holly Sugar Corp., and Great Western Sugar Co. produced lime for use in metallurgical processes, sewage treatment, and sugar refining.

Phosphate Rock.—Phosphate rock was mined in Powell County and shipped to Canada for use in making fertilizer. The Stauffer Chemical Co., Silver Bow County, imported phosphate rock from Idaho for its elemental phosphorus plant.

Sand and Gravel.—Sand and gravel produced in Montana was used primarily for construction, roadbase and coverings, con-

Table 8.—Montana: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,263	$3,592	$2.84	2,150	$5,856	$2.72	1,657	$4,592	$2.77
Plaster and gunite sands	NA	NA	NA	W	W	W	9	35	3.84
Concrete products	86	222	2.60	W	W	W	85	256	3.01
Asphaltic concrete	403	1,172	2.91	656	1,818	2.77	1,073	2,559	2.39
Roadbase and coverings	2,380	3,978	1.67	2,711	5,036	1.86	3,358	6,218	1.85
Fill	527	806	1.53	630	959	1.59	739	1,273	1.72
Snow and ice control	NA	NA	NA	40	65	1.63	61	116	1.91
Railroad ballast	--	--	--	97	204	2.10	15	42	2.80
Other uses	17	19	1.08	15	15	1.00	15	15	1.00
Total[1] or average	4,675	9,789	2.09	6,391	14,230	2.23	7,012	15,106	2.15

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Table 9.—Montana: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	1,134	$2,340	$2.06	2,184	$5,378	$2.46	1,697	$4,371	$2.58
Gravel	3,541	7,449	2.10	4,207	8,862	2.10	5,315	10,735	2.02
Total or average	4,675	9,789	2.09	6,391	14,230	2.23	7,012	15,106	2.15
Industrial sand	192	633	3.30	W	W	W	--	--	--
Grand total[1] or average	4,867	10,421	2.14	W	W	W	7,012	15,106	2.15

W Withheld to avoid disclosing company proprietary data.

[1] Data may not add to totals shown because of independent rounding.

Table 10.—Montana: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate	--	--	16	40	--	--
Bituminous aggregate	W	W	3	7	--	--
Dense-graded roadbase stone	109	275	31	68	59	140
Surface treatment aggregate	118	234	75	144	W	491
Other construction aggregate and roadstone	1,025	2,229	741	1,701	184	425
Riprap and jetty stone	66	124	107	224	84	195
Cement manufacture	1,124	2,142	W	W	W	W
Lime manufacture	[2]651	[2]1,468	312	777	319	833
Flux stone	99	382	128	476	160	563
Bedding material	--	--	5	6	--	--
Fill	--	--	3	8	18	62
Other uses[3]	489	1,129	1,767	4,283	1,703	5,097
Total[4]	3,680	7,923	3,188	7,733	2,527	7,806

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, sandstone, traprock, and miscellaneous stone (1977-78).

[2] Includes sugar refining.

[3] Includes stone used for railroad ballast, filter stone (1978), terrazzo and exposed aggregate (1978), ferrosilicon (1978-79), sugar refining (1978-79), and uses indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

crete aggregate, asphaltic concrete, fill, plaster and granite sands, concrete products, and as railroad ballast. A minor amount was used for snow and ice control.

Stone.—Crushed stone produced in the State was used for the manufacture of cement, roadstone, lime manufacture, flux, riprap and jetty, surface treatment, road base, concrete, bedding, railroad ballast, sugar refining, ferrosilicon, exposed aggregate, and as filler. More than 75% of the State's stone production came from quarries yielding in excess of 100,000 short tons per year. However, annual production from approximately 80% of the quarries operating in the State was less than 25,000 short tons.

Sulfur.—Two companies in Yellowstone County recovered sulfur as a byproduct from petroleum facilities.

Talc.—Talc production continued at a high rate from Cyprus' Yellowstone and Beaverhead Mines and from Pfizer Inc.'s Treasure Mine, all in Madison County. Cyprus acquired Resource Processors, Inc. a firm that mined talc at the Willow Creek Mine. Most talc was shipped out of Montana for use in the manufacture of paper, paint, refractories, toilet preparations, ceramics, roofing materials, insecticides, and in rice polishing. Interest in and exploration for talc continued in southwestern Montana.

Chlorite, having some of the same uses as talc, was mined from a recently developed deposit near Silver Star.

Vermiculite.—W. R. Grace & Co. produced crude vermiculite from its Rainy Creek Mine in Lincoln County, primarily for further treatment and sale outside of Montana. The mine, which was the largest source of crude vermiculite in the United States, was idled by a strike for 3 weeks in 1978. Its production in 1979 was approximately the same as in 1978. Neither year's production quite equaled that of 1977.

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[1] State mineral specialist, Bureau of Mines, Spokane, Wash.

[2] Staff field agent, Montana Bureau of Mines and Geology, Butte, Mont.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum:			
Anaconda Aluminum Co	Columbia Falls, MT 59912	Reduction plant	Flathead.
Antimony:			
U.S. Antimony Corp	Box 643 Thompson Falls, MT 59873	Mine and plant	Sanders.
Barite:			
Montana Barite Co	Box 3296 Missoula, MT 59801	do	Missoula.
Cement:			
Ideal Basic Industries, Inc.[1]	Box 8789 Denver, CO 80201	Plant	Gallatin.
Kaiser Cement and Gypsum Corp.[1]	300 Lakeside Dr. Oakland, CA 94666	do	Jefferson.
Clays:			
International Minerals and Chemical Corp.	Box 460 Belle Fourche, SD 57717	Pit	Carter.
American Colloid Co.	5100 Suffield Ct. Skokie, IL 60067	Plant and pit	Carbon and Phillips.
Federal Bentonite Div., Aurora Metal Co.	1019 Jerico Rd. Aurora, IL 60538	do	Valley.
Copper:			
The Anaconda Copper Co.[2]	Anaconda, MT 59701	Smelter, refinery, mine, plant.	Silver Bow.
Gypsum:			
U.S. Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	Underground mine and plant.	Fergus.
Iron ore:			
R & S Iron Co	Radersburg, MT 59644	Mine	Meagher.
Phosphate rock:			
Cominco American, Inc	Garrison, MT 59731	do	Powell.
Stauffer Chemical Co	229 Park Ave. New York, NY 10017	Plant	Silver Bow.
Sand and gravel:			
Barry O'Leary Inc	Box 1102 Billings, MT 59101	Pit	Yellowstone.
McElroy and Wilkin Inc	Box 35 Kalispell, MT 59901	Pit	Flathead.
Midland Materials Co	Box 2521 Billings, MT 59103	Pit	Yellowstone.

See footnotes at end of table.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel: —Continued			
Northern Materials Co., Inc	Box 1690 Great Falls, MT 59401	Pit	Cascade.
Peter Kiewitt Sons Co.[3]	Box 20096 Billings, MT 59102	Pit	Yellowstone.
Plenty Coups Sand and Gravel	Box 20833 Billings, MT 59101	Pit	Do.
Schellinger Construction Co	Box 517 Columbia Falls, MT 59912	Pit	Flathead.
Western Materials, Inc	Box 2790 Missoula, MT 59801	Pit	Missoula.
Silver:			
ASARCO Inc.[4]	120 Broadway New York, NY 10005	Smelter	Lewis and Clark.
Stone:			
Big Horn Calcium Co	Box 118 Frannie, WY 82423	Pits	Carbon and Granite.
Janney Construction Co., Inc	Box 517 Deer Lodge, MT 59722	Pit	Missoula.
Montana Highway Dept	Helena, MT 59601	Pits	Various.
U.S. Forest Service, Region 1	Missoula, MT 59801	Pit	Do.
Sulfur:			
Montana Sulphur and Chemical Co.	Box 31118 Billings, MT 59107	Plant	Yellowstone.
Talc:			
Cyprus Industrial Minerals Co	555 South Flower St. Los Angeles, CA 90017	Open pit mine and plant	Madison.
Pfizer, Inc	Box 1147 Dillon, MT 59725	do	Madison and Beaverhead
Vermiculite, crude:			
W. R. Grace & Co.	62 Whittemore Ave. Cambridge, MA 02140	do	Lincoln.

[1] Also clays and stone.
[2] Also aluminum, gold, lime, silver, and stone.
[3] Also stone.
[4] Also lead, copper, and gold.

[illegible]

The Mineral Industry of Nebraska

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Conservation and Survey Division of the University of Nebraska, Nebraska Geological Survey, for collecting information on all nonfuel minerals.

By Robert H. Arndt[1] and Raymond R. Burchett[2]

The value of nonfuel minerals produced in Nebraska rose in the 1978-79 biennium to a new record of about $99 million in 1979, supported by increased unit prices and total values of most mineral commodities, but only partially supported by increased output of minerals. Total value of nonfuels increased 83% in the 5-year period, 1975-79. Output of sand and gravel in the biennium was actually lower than output in 1977, the year of highest production during 1975-79. Clays behaved similarly. Outputs of stone and cement were higher in 1979 than in 1975, although the general rise of stone output to the 1979 level was interrupted by a slight reversal in 1976. Production of lime decreased in 1975-79, but because output of lime was relatively small and average unit prices fluctuated irregularly from year to year, the value of lime had little influence on the trend in mineral value. About 1,600 workers were employed in mining nonfuel minerals in 1978, a decrease from 1,800 employed in 1977.

Legislation and Government Programs.—No attention was given to nonfuel mineral industries by the Nebraska Legislature during 1978 and 1979. The future status of these industries continued to be addressed through the program of the Nebraska Geological Survey. Geologic mapping in southeastern Nebraska was directed

Table 1.—Nonfuel mineral production in Nebraska[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	161	$368	146	$418	156	$454
Gem stones	NA	11	NA	W	NA	W
Sand and gravel thousand short tons	[2]16,848	[2]30,566	16,720	31,910	16,197	33,001
Stone (crushed) do	4,128	12,974	4,201	14,758	4,995	19,362
Combined value of cement, lime, sand and gravel (industrial, 1977), and values indicated by symbol W	XX	34,174	XX	36,287	XX	46,364
Total	XX	78,093	XX	83,373	XX	99,181

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Nebraska, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Antelope	$400	$434	Sand and gravel.
Banner	218	126	Do.
Brown	W	W	Do.
Buffalo	1,722	1,053	Do.
Burt	W	W	Do.
Butler	556	519	Do.
Cass	W	W	Cement, stone, sand and gravel, clays.
Cedar	412	605	Sand and gravel.
Chase	178	166	Do.
Cherry	W	W	Do.
Cheyenne	55	35	Do.
Clay	W	W	Do.
Colfax	W	262	Do.
Cuming	823	1,216	Do.
Custer	265	785	Do.
Dawson	1,125	1,156	Do.
Deuel	W	92	Do.
Dixon	W	W	Sand and gravel, stone.
Dodge	1,165	1,050	Sand and gravel.
Douglas	W	W	Sand and gravel, clays.
Dundy	267	267	Sand and gravel.
Fillmore	W	W	Do.
Franklin	1,006	1,066	Do.
Frontier	W	W	Do.
Furnas	185	135	Do.
Gage	1,187	1,239	Sand and gravel, stone.
Garden	97	W	Sand and gravel.
Garfield	24	24	Do.
Greeley	W	W	Do.
Hall	1,429	1,516	Do.
Hamilton	313	W	Do.
Hayes	W	W	Do.
Hitchcock	W	W	Do.
Holt	556	914	Sand and gravel, stone.
Hooker	8	8	Sand and gravel.
Howard	235	235	Do.
Jefferson	W	W	Sand and gravel, clays.
Kearney	84	59	Sand and gravel.
Keith	170	110	Do.
Kimball	5	5	Do.
Knox	221	281	Do.
Lancaster	W	W	Stone, clays, sand and gravel.
Lincoln	725	819	Sand and gravel.
Loup	9	97	Do.
Madison	1,218	1,249	Do.
Merrick	452	471	Do.
Morrill	W	W	Sand and gravel, lime.
Nance	403	515	Sand and gravel.
Nemaha	W	W	Stone, sand and gravel.
Nuckolls	W	W	Cement, sand and gravel, stone.
Otoe	W	W	Stone.
Pawnee	W	W	Do.
Perkins	--	17	Sand and gravel.
Phelps	58	W	Do.
Pierce	448	448	Do.
Platte	1,212	1,178	Do.
Polk	W	189	Do.
Red Willow	170	299	Do.
Richardson	W	W	Stone, sand and gravel.
Rock	6	W	Sand and gravel.
Saline	165	52	Do.
Sarpy	W	W	Stone, sand and gravel, clays.
Saunders	W	W	Sand and gravel, stone.
Scotts Bluff	W	W	Sand and gravel, lime.
Seward	30	35	Stone.
Sheridan	280	265	Sand and gravel.
Stanton	438	263	Do.
Thayer	510	966	Do.
Thomas	W	W	Do.
Valley	33	35	Do.
Washington	W	W	Stone.
Webster	320	318	Sand and gravel.
York	81	199	Do.
Undistributed[2]	58,826	62,594	
Total[3]	78,093	83,373	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] The following counties are not listed because no nonfuel mineral production was reported: Adams, Arthur, Blaine, Boone, Box Butte, Boyd, Dakota, Dawes, Gosper, Grant, Harlan, Johnson, Keya Paha, Logan, McPherson, Sherman, Sioux, Thurston, Wayne, and Wheeler.

[2] Includes gem stones, sand and gravel, and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Nebraska business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	749.0	772.0	772.0	--
Unemployment	do	28.0	23.0	24.0	+4.3
Employment (nonagricultural):					
Mining[1]	do	1.8	1.8	1.7	-5.6
Manufacturing	do	90.6	94.1	99.1	+5.3
Contract construction	do	32.3	33.0	33.5	+1.5
Transportation and public utilities	do	42.0	43.8	46.3	+5.7
Wholesale and retail trade	do	156.0	158.9	164.0	+3.2
Finance, insurance, real estate	do	37.7	39.5	40.9	+3.5
Services	do	104.1	108.8	114.3	+5.1
Government	do	129.2	130.3	127.0	-2.5
Total nonagricultural employment[1]	do	593.7	[2]609.9	626.8	+2.8
Personal income:					
Total	millions	$10,382	$11,809	$13,129	+11.2
Per capita		$6,677	$7,544	$8,341	+10.6
Construction activity:					
Number of private and public residential units authorized		11,322	[3]10,937	9,157	-16.3
Value of nonresidential construction	millions	$106.4	$132.6	$169.4	+27.8
Value of State road contract awards	do	$70.0	$70.0	$85.0	+21.4
Shipments of portland and masonry cement to and within the State	thousand short tons	1,022	994	1,072	+7.8
Nonfuel mineral production value:					
Total crude mineral value	millions	$78.1	$83.4	$99.2	+18.9
Value per capita, resident population		$50	$53	$63	+18.9
Value per square mile		$1,011	$1,080	$1,284	+18.9

[p] Preliminary.
[1] Includes oil and gas extraction.
[2] Data do not add to total shown because of independent rounding.
[3] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

toward identification of limestone resources and potential future quarry sites. Surveys were underway to show consolidated bedrock, bedrock exposures, and distribution and thickness of unconsolidated mantle rock in the Sioux City, McCook, North Platte, and Scottsbluff 2° quadrangles. The survey also made an annual inventory of surface mines, acreage disturbed and acreage reclaimed. A map of Nebraska on a scale of 1 inch = 16 miles was published in 1978, showing location of active mines, pits, quarries, and energy deposits. Fourteen accompanying small maps depict the general distribution of the nonfuel minerals, sand and gravel, quartzite, limestone, clay and shale, volcanic ash, gypsum, and bentonite. Also depicted are the reported occurrences of diatomaceous earth, sodium and potassium salts, metallic minerals, groundwater, peat, and several energy materials and related installations at or near the land surface.

Gilbert Corp. of Delaware, Inc., Omaha, was awarded a contract by the Bureau of Mines to construct an underground mine laboratory for the Bureau's Lake Lynn Laboratory at Wymps Gap, Pa. The Bureau planned to use the laboratory for research in mine fires and explosions.

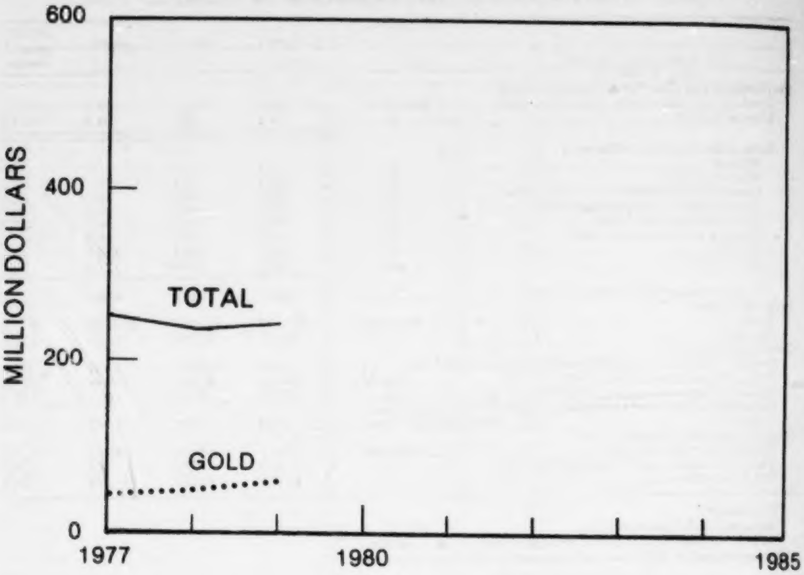

Figure 1.—Value of gold and total value of nonfuel mineral production in Nevada.

the Con-Imperial pit and protect historic houses and landmarks. Late in 1978, the company obtained the necessary State permits to operate a gold processing plant near Manhattan in Nye County. The plant will employ 60 people.

Late in 1979, Anaconda announced its decision to begin construction on a mining and milling complex to treat molybdenum ore in Nye County about 20 miles northwest of Tonapah. Development costs will approach $22 million, and the project will employ nearly 400 people. Estimated life of the mine and open pit operation is 20 years.

Resumption of large-scale tungsten mining near Imlay, in Humboldt County, was announced by Utah International in 1979. The company submitted an application to the State for permission to construct the $50 million facility.

Drilling exploration for metals and nonmetals continued at an alltime high for both years. The principal metal ores involved were gold, silver, tungsten, and molybdenum; barite, gypsum, and clay were the principal nonmetallics. Several exploration companies are reevaluating and drilling in and along the Roberts Mountain thrust fault. This mineralized zone in the fault system extends from the southwest to the northwest in north-central Nevada. Freeport Minerals Co. announced in April 1978, the discovery of a substantial gold deposit in Jerritt and Marlboro Canyons, within the Humboldt National Forest in Elko County. This deposit is significant; the company staked claims covering 42 square miles. A company called Freeport Gold Co., a subsidiary of Freeport Minerals and FMC, was formed to continue evaluation of the property and to be the operator. In late 1979, environmental baseline studies commenced for a draft environmental impact statement on the mine. Under an option agreement, Freeport was also exploring a block of claims of the Owyhee Syndicate, near Tuscarora. Geochemical surveys and rotary drilling indicate that measurable gold values are present over much of the area.

Amselco Minerals, Inc., a wholly owned U.S. subsidiary of Selection Trust Ltd. of London, anounced a major gold discovery from the manufacturers. About 75% of the cement was shipped by truck; almost all of the remainder went by rail.

Clays.—Nebraska's small clay output fluctuated in the 5 years (1975-79). Production increased modestly in 1979 from that of 1978, the lowest in the 5-year period. Meanwhile, the value of produced clay increased during the biennium to the highest level of the period. This was a consequence of almost steady growth in the unit value of clay from just over $2 per ton in 1975 to almost $3 per ton in 1979. Four producing firms mined common clay and shale in Cass, Douglas, Jefferson, Lancaster, and Sarpy Counties in the southeastern part of the State. Face brick and common brick were manufactured in Douglas, Lancaster, and Sarpy Counties.

Lime.—Output of lime by Great Western Sugar Co. during the biennium was less than that in the 3 previous years. The value of lime also fell below that of 1975 and fluctuated irregularly during 1976-79. In 1979, lime values rose to the highest level experienced after 1975. Lime was prepared in kilns at the firm's sugar plants at Bayard, Scottsbluff, Gering, and Mitchell. The output of lime relates generally to the size of the sugar beet crop to be processed to sugar at the firm's four plants, where lime is used to generate carbon dioxide and as a purifier in the refining process. Limestone for the industry came from the firm's quarry near Horse Creek, Wyo., and from a commercial supplier in the vicinity of Rapid City, S. Dak. The firm requires stone that contains a minimum of 95% calcium carbonate.

Sand and Gravel.—Sand and gravel led all raw mineral commodities produced in Nebraska during the biennium both in quantity and value. Although output in the biennium was reduced from that of 1977, it exceeded by far that output in 1975 and 1976. The value of the output, on the other hand, experienced continued growth during the biennium to more than $33 million in 1979, almost twice the total value in 1975. Growth in value was supported by the increase in output and the increase in the average unit price of sand and gravel from nearly $1.50 per ton in 1975 to $2.04 per ton in 1979. The combined output from Douglas, Saunders, Hall, Cass, Madison, and Buffalo Counties in 1978, and the output from Douglas, Saunders, Dodge, and Hall Counties in 1979 exceeded 35% of the State's total output of sand and gravel each year. One hundred and sixty-five firms produced sand and gravel in 1978. In 1975, 153 firms were active. That year, two firms supplied about 30% of the State's sand and gravel, and more than 50% of the State's output came from the combined output of seven firms. Sand and gravel was recovered in 69 counties in 1978-79, from 263 deposits in 1978 and 237 deposits in 1979. Individual company output both years ranged from less than 200 tons to more than 2 million tons. Fifty percent of the output of sand and gravel in 1978 was from deposits that yielded less than 100,000 tons during the year. In 1979, about 40% of the output came from 206 deposits that supported operations in the same size range. By contrast, almost 35% of the output in 1978 came from deposits that individually yielded over 200,000 tons; in 1979, 14 deposits in that production category provided nearly 40% of the State's total output. Thirty-four deposits yielded 100,000 to 200,000 tons in 1978, and 17 had similar yields in 1979. The distribution of streams and associated deposits of sand and gravel in streambeds, flood plains, and alluvial terraces relate directly to production. Sand and gravel operations are prominent along the Platte, Republican, Niobrara, Elk Horn, Blue, Big Sandy, and many other rivers, and in the interstream areas along the northern border of the State and in the western part of the State. Almost 58% of the State's total tonnage and 56% of the value of sand and gravel produced in 1978 were derived from counties that adjoin the Platte River. Output increased in 1979 to more than 68% of the State total and almost 66% of the value. Combined output of sand and gravel from counties adjacent to the Republican and Platte Rivers was about 66% of the State's total output in 1978 and almost 72% of that in 1979. Relatively large production from the counties adjacent to the Platte and Republican Rivers was achieved because of the abundant presence of the materials, the presence of at least 11 of the major cities in Nebraska, including Omaha, in those counties, and to the traditional use of the Platte valley as an east-west corridor across the State for construction and maintenance of railways and highways. These factors supported abundant construction and heavy demands for sand and gravel, a primary construction material. Major uses of sand and gravel are as aggregates, roadbases, fill, concrete products, plaster and gunite sands, snow and ice control, and railroad ballast. Construction aggregates, the largest single use, required almost 49% of the total output in 1978 and

Table 4.—Nebraska: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	4,804	$9,445	$1.97	4,745	$9,297	$1.96	3,814	$7,526	$1.97
Plaster and gunite sands	NA	NA	NA	144	258	1.78	117	208	1.78
Concrete products	984	2,282	2.32	767	1,738	2.27	1,005	2,189	2.18
Asphaltic concrete	3,331	6,459	1.94	3,396	6,834	2.01	2,697	5,492	2.04
Roadbase and coverings	4,955	8,975	1.81	5,275	10,607	2.01	7,010	15,404	2.20
Fill	2,605	3,123	1.20	2,342	3,009	1.28	1,452	1,921	1.32
Snow and ice control	NA	NA	NA	16	22	1.36	24	44	1.83
Railroad ballast	W	W	W	--	--	--	40	149	3.74
Other uses	167	281	1.75	33	141	4.28	38	67	1.78
Total[1] or average	16,848	30,566	1.81	16,720	31,910	1.91	16,197	33,001	2.04

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Table 5.—Nebraska: Construction sand and gravel sold or used by producers

	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	6,043	$10,843	$1.79	6,984	$12,739	$1.82	5,459	$10,070	$1.84
Gravel	10,805	19,724	1.83	9,735	19,167	1.97	10,738	22,931	2.14
Total[1] or average	16,848	30,566	1.81	16,720	31,910	1.91	16,197	33,001	2.04

[1] Data may not add to totals shown because of independent rounding.

more than 40% in 1979. Roadbases accounted for almost 32% of the product use in 1978 and more than 43% in 1979. Requirements for fill and concrete products were considerably smaller, whereas those for plaster and gunite sand, snow and ice control, railroad, and all other uses individually accounted for less than 1% of the total output. The modes of transportation of sand and gravel reflected the proximity of the exploited deposits to the point of use. During the biennium, about 89% of the sand and gravel was transported by truck, 7.5% to 9.0% was moved by rail, only a minute quantity was moved in any other manner; and 4% to 5% was used at the source.

Stone.—Preparation of aggregates and cement are the principal uses for stone, which ranked second in both quantity and value among the raw nonfuel minerals produced in Nebraska. Output in 1979 was the highest in the period 1975-79. It followed relatively low production in 1976 and 1977 and recovering production in 1978. The value of produced stone increased steadily to $19.4 million in 1979, the highest value in the 5-year period. Both increased production and a growth in the average unit value of stone from about $2.40 per ton for crushed stone in 1975 to $3.88 per ton in 1979 supported the high value of Nebraska stone output. The value of crushed stone used for specific purposes ranged from less than $2 per ton to more than $11 per ton in 1979. Growth of the average unit value between 1975 and 1979 was almost 60%.

Counties along the eastern boundary of the State, especially near Omaha, and in the southeast were the main sources of stone. Dixon County in the northeast had a small stone industry in both years of the biennium, and Holt County in the north-central part of the State supplied stone in 1978. Cass, Washington, and Saunders Counties were the most productive counties, providing more than 85% of the output and value of stone in the State during the biennium. Stone was produced in 14 counties from a total of 24 quarries and by 15 firms in 1978. The 12 source counties in 1979 had 22 quarries; 13 firms were active. Quarry operations ranged in size from about 1,000 tons per year to 1 million tons per year. Four quarries exceeded 500,000 tons output in both years. Four had production between 100,000 and 500,000 tons per year in 1978, and six had similar production in 1979. Sixteen quarries in 1978 and 12 in 1979 had production of less than 100,000 tons per year. Output from quarries in this category was just over 12% of the State's total output in 1978 and almost 8% in 1979. By contrast, the four largest producing quarries supplied more than 68% of the State's total production in both years.

Only limestone was quarried. It was marketed as crushed stone. During the biennium, almost two-thirds of the crushed stone was used as aggregates, including those to be used with concrete and bituminous materials for surface treatment of roads and other unspecified activities. Other uses—agricultural stone, riprap and jetty stone, and mineral foods—required from 1% to 5% of total output. Quantities of crushed stone sold for flux, dense roadbase, railroad ballast, asphalt filler, and filter stone were each generally less than 1%. As a commodity of relatively low value, stone tends to be produced as close to the market as possible. Thus, about 84% of all the stone transported in the State was shipped by truck. Railroads handled almost 14% of the stone. About 2% of the stone was carried by waterway, principally, on the Missouri River. Less than 0.5% of the stone was carried by other means.

Table 6.—Nebraska: Crushed limestone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	196	509	157	478	167	589
Poultry grit and mineral food	W	W	W	W	257	2,867
Concrete aggregate	1,253	4,034	1,432	4,992	1,154	4,696
Dense-graded roadbase stone	187	579	40	W	W	W
Surface treatment aggregate	604	1,776	812	2,951	829	3,408
Other construction aggregate and roadstone	331	1,142	209	785	910	3,594
Riprap and jetty stone	68	195	209	907	189	871
Flux stone	5	W	--	--	4	17
Asphalt filler	41	287	W	W	W	W
Other uses[1]	1,442	4,451	1,343	4,645	1,486	3,321
Total[2]	4,128	12,974	4,201	14,758	4,995	19,362

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes stone used in bituminous aggregate, railroad ballast, filter stone (1977-78), cement manufacture, and data indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Talc.—Cyprus Industrial Minerals Co. ground talc from southwestern Montana at its Grand Island mill. The ground talc was sold for use in manufacturing a wide range of personal, ceramic, plastic, and other products.

Vermiculite.—W. R. Grace & Co., Construction Products Division, exfoliated vermiculite from Libby, Mont., in its plant near Omaha. Exfoliated vermiculite was used as concrete and plaster aggregate, loose fill and block insulation, for horticulture and soil conditioning, and in fireproofing.

METALS

Lead bullion from smelters was processed at the Omaha refinery of ASARCO Inc., to produce refined and antimonial lead and refined bismuth. The refinery also recovered antimony, antimony oxide, dore containing silver and gold, copper, and zinc. Late in 1978, the firm completed construction and put onstream an automated, enclosed, and environmentally clean plant designed to produce 2,700 tons of antimony oxide per year. Total rated annual capacity of the refinery is 180,000 tons of metal.

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[1] State mineral specialist, Bureau of Mines, Denver, Colo.

[2] Research geologist, Nebraska Geological Survey, Lincoln, Nebr.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ash Grove Cement Co.[1]	920 Main St. Suite 1000 Kansas City, MO 64105	Plant	Cass.
Ideal Basic Industries, Inc., Ideal Cement Co.	420 Ideal Cement Bldg. Denver, CO 80202	do	Nuckolls.
Clays:			
Endicott Clay Products Co	Box 17 Fairbury, NE 68352	Open pit and plant	Jefferson.
Yankee Hill Brick Manufacturing Co.	Route 1 Lincoln, NE 68502	do	Lancaster.
Lead, refined:			
ASARCO, Inc.[2]	5th and Douglas Sts. Omaha, NE 68102	Refinery	Douglas.
Lime:			
Great Western Sugar Co	Box 5038 Denver, CO 80217	Plants	Morrill and Scotts Bluff.
Sand and gravel:			
Ace Sand & Gravel Co	Box 865 Columbus, NE 68601	Pits and plants	Nance and Platte.
Behrens Construction Co	Box 188 Beatrice, NE 68310	do	Gage.
Central Sand & Gravel Co	Box 626 Columbus, NE 68601	do	Butler, Madison, Platte.
Elkhorn Construction Co	Box 168 Norfolk, NE 68701	do	Madison.
Gayman Sand & Gravel Co	Tryon Route Box 2 North Platte, NE 69101	Pit and plant, dredge and plant.	Lincoln and Scotts Bluff.
Hartford Sand & Gravel Co.	Box Z Valley, NE 68064	Dredge and pits	Dodge and Douglas.
Kirkpatrick Sand & Gravel Co.	Box 6 Lexington, NE 68850	Pit and plant	Dawson.
Luther & Maddox Gravel Co	3000 South Blaine St. Grand Island, NE 68801	Pits and plants	Hall.
Lyman-Richey Sand & Gravel Corp	4315 Cuming St. Omaha, NE 68161	do	Cass, Dodge, Douglas, Morrill, Platte, Saunders.
Midwest Bridge and Construction	Box 787 Norfolk, NE 68701	do	Holt, Pierce, Stanton.
Nichols Construction Co	Geneva, NE 68361	do	Fillmore and Thayer.
Olson Sand & Gravel Co.	Alma, NE 68920	Pit	Franklin.
Overland Sand & Gravel Co	Box 307 Stromsberg, NE 68666	Pits and plants	Hamilton, Merrick, Nance, Polk.
Stalp Gravel Co.	Route 3 West Point, NE 68788	Pit and plant	Cuming.
Western Sand & Gravel Co	Box 80268 Lincoln, NE 68501	Pits and plants	Cass, Dodge, Saunders.
Stone:			
City Wide Rock & Excavation Co	3863 Mason St. Omaha, NE 68105	Quarries and plants.	Sarpy.
Fort Calhoun Stone Co	1255 South St. Blair, NE 68008	do	Washington.
Hopper Brothers Quarries	Box 383 Weeping Water, NE 68463	do	Cass, Gage, Nemaha, Nuckolls, Otoe, Pawnee, Richardson, Saunders.
Kerford Limestone Co	Box 434 Weeping Water, NE 68463	Quarry and plant	Cass.
Talc, ground:			
Cyprus Industrial Minerals Co., Talc Div.	Box 1502 Grand Island, NE 68801	Concentrator	Hall.
Vermiculite, exfoliated:			
W. R. Grace & Co., Construction Products Div.	62 Whittemore Ave. Cambridge, MA 02140	Plant	Douglas.

[1] Also clays and stone.

[2] Also antimonial lead, bismuth, antimony oxide, dore containing silver and gold, copper, and zinc.

The Mineral Industry of Nevada

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Nevada Bureau of Mines and Geology, for collecting information on all nonfuel minerals.

By D. W. Lockard[1] and John H. Schilling[2]

Nevada nonfuel mineral production for 1978 was $237 million and for 1979 it was $238 million. Values in both years were somewhat less than the record output of $270 million in 1977. The lower value was primarily the result of lower copper production. Nevada saw the value of its produced copper fall from nearly $90 million in 1977 to less than $1 million in 1979. This was due to depressed market conditions for the past 2 years and mine closures of Kennecott Copper Corp. at McGill, and the Anaconda Co.'s Yerington facility in Lyon County. Renewed environmental regulations, primarily air standards, also played an important part in decline of the State's copper industry.

The State produced 24 mineral commodities in 1977, and 25 each in 1978 and 1979.

During 1978-79, exploration and development of gold-silver properties continued with a significant upswing. Discovery of new precious metal deposits, coupled with rising prices and reevaluation of old mining districts, kept the spotlight on Nevada for both years. It was estimated that during 1978 more than $75 million was spent on hard rock mineral exploration throughout Nevada.

Trends and Developments.—The State's copper industry was in the news extensively during the past 2 years. Since the early 1930's, and through 1977, copper accounted for about 60% of the State's total mineral output value. In 1978, the three leading producers shut down, citing poor copper market conditions and environmental restrictions as reasons for their closures. Officials from Anaconda, the Walker River Irrigation District, and Lyon County, began meeting early in 1978 to consider what to do with the big open pit at Anaconda's Yerington site. The proposal receiving the most consideration was to use the pit to store excess water for use in irrigation. An engineering study found the reservoir idea feasible; however, no work had begun on the project by yearend 1979. In 1978, the Anaconda Co. leased its Victoria Mine in Elko County to Day Mines, Inc.; Day Mines spent most of 1979 in performing evaluation and feasibility studies.

Kennecott closed its open pit mine at Ruth and a concentrator at McGill on May 1, 1978, laying off more than 450 employees. About 300 employees remained at the McGill smelter to process copper concentrate shipped by rail from Kennecott's Utah operation. Kennecott also began engineering feasibility studies on recovering copper from tailings at McGill. The firm continued to be involved in a controversy with the U.S. Environmental Protection Agency (EPA) about air quality. Early in 1978, EPA rejected results of an air quality report prepared by the Nevada Division of Environmental Protection that placed the McGill smelter in a special category. An injunction granted by the U.S. District Court against EPA required that agency to approve the variance, but the U.S. Ninth Circuit Court of Appeals later set aside the

Table 1.—Nonfuel mineral production in Nevada[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Barite ______ thousand short tons__	1,158	$18,329	1,788	$30,034	1,734	$34,320
Cement, portland __________do____	W	W	431	22,163	W	W
Clays__________________do____	[2]10	[2]158	51	514	76	1,163
Copper (recoverable content of ores, etc.) ____________metric tons__	60,837	89,593	20,453	29,986	[3]123	[3]253
Gem stones ____________________	NA	1,000	NA	1,000	NA	1,000
Gold (recoverable content of ores, etc.) troy ounces__	324,003	48,053	260,895	50,496	199,960	61,488
Gypsum ____ thousand short tons__	1,242	6,834	1,335	7,883	1,075	6,771
Lead (recoverable content of ores, etc.) metric tons__	674	456	653	485	24	28
Mercury ________ 76-pound flasks__	W	W	24,163	3,705	29,368	8,256
Molybdenum ___________pounds__	W	W	99,311	469	39,826	242
Perlite _____ thousand short tons__	W	W	6	75	5	71
Pumice_________________do____	656	1,154	706	1,282	W	W
Sand and gravel __________do____	10,185	21,172	[4]10,040	[4]22,620	[4]10,498	[4]21,387
Silver (recoverable content of ores, etc.) thousand troy ounces__	738	3,411	804	4,341	529	5,862
Stone (crushed) thousand short tons__	1,668	5,506	1,426	5,489	1,602	6,439
Tungsten (W content) thousand pounds__	263	1,687	W	W	W	W
Zinc (recoverable content of ores, etc.) metric tons__	1,517	1,150	1,371	937	W	W
Combined value of clays (common clay, fuller's earth, and kaolin, 1977), diatomite, fluorspar, iron ore, lime, lithium compounds, magnesite, salt, sand and gravel (industrial, 1978-79), talc, and values indicated by symbol W____________________	XX	65,313	XX	55,930	XX	90,870
Total__________________	XX	263,816	XX	237,409	XX	238,150

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Combined value" figure.
XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes common clay, fuller's earth, and kaolin; value included in "Combined value" figure.

[3] Incomplete data.

[4] Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Nevada, by county

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Carson City____________	$358	$252	Pumice, sand and gravel, stone.
Churchill ____________	1,460	W	Diatomite, sand and gravel, tungsten, salt, silver, stone, lead.
Clark________________	32,453	38,199	Sand and gravel, lime, gypsum, stone, tungsten.
Douglas ______________	W	W	Sand and gravel, silver, gold, stone, copper.
Elko ________________	13,084	W	Barite, gold, tungsten, sand and gravel, copper, lead, silver, zinc.
Esmeralda ___________	12,556	15,836	Lithium, diatomite, sand and gravel, talc, clays.
Eureka ______________	W	30,674	Gold, iron ore, barite, sand and gravel, silver, stone, mercury, lead, zinc.
Humboldt_____________	4,344	4,075	Mercury, stone, sand and gravel, clays.
Lander_______________	32,700	30,423	Barite, copper, gold, silver, sand and gravel, lead, zinc.
Lincoln ______________	5,478	8,969	Tungsten, gold, silver, zinc, lead, lime, perlite, sand and gravel, clays, copper.
Lyon ________________	58,034	37,538	Cement, copper, stone, sand and gravel, diatomite, gypsum.
Mineral ______________	56	W	Tungsten, sand and gravel, stone.
Nye ________________	11,464	20,259	Gold, barite, magnesite, sand and gravel, clays, fluorspar, silver, pumice, tungsten.
Pershing _____________	13,711	14,295	Diatomite, gypsum, iron ore, copper, tungsten, sand and gravel, gold, perlite, clays.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Nevada, by county —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Storey	$6,168	$7,924	Diatomite, silver, gold, sand and gravel.
Washoe	W	W	Sand and gravel, pumice, clays.
White Pine	W	W	Copper, gold, molybdenum, silver, tungsten, sand and gravel.
Undistributed[1]	71,952	28,965	
Total	[2]263,816	237,409	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1] Includes sand and gravel that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.
[2] Data do not add to total shown because of independent rounding.

Table 3.—Indicators of Nevada business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	323.0	338.0	358.0	+5.9
Unemployment do	23.0	15.0	18.0	+20.0
Employment (nonagricultural):				
Mining do	4.4	4.2	4.6	+9.5
Manufacturing do	15.1	17.8	19.5	+9.6
Contract construction do	19.3	25.5	27.2	+6.7
Transportation and public utilities do	18.8	20.9	23.0	+10.0
Wholesale and retail trade do	61.2	69.2	77.3	+11.2
Finance, insurance, real estate do	12.8	14.4	16.8	+16.7
Services do	127.4	145.8	160.0	+9.7
Government do	49.2	52.2	54.7	+4.8
Total nonagricultural employment[1] do	308.2	350.3	383.1	+9.4
Personal income:				
Total millions	$5,224	$6,222	$7,163	+15.1
Per capita	$8,202	$9,377	$10,204	+8.8
Construction activity:				
Number of private and public residential units authorized	20,396	[2]25,620	18,962	-26.0
Value of nonresidential construction millions	$247.4	$316.1	$350.1	+10.8
Value of State road contract awards do	$56.0	$70.0	$43.7	-37.6
Shipments of portland and masonry cement to and within the State thousand short tons	511	613	610	-.5
Nonfuel mineral production value:				
Total crude mineral value millions	$263.8	$237.4	$238.2	+.3
Value per capita, resident population	$414	$360	$339	-26.3
Value per square mile	$2,387	$2,148	$2,154	+.3

[p] Preliminary.
[1] Includes oil extraction.
[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

injunction. The controversy continued through 1979, with the State Division of Environmental Protection in the Governor's office determining the McGill smelter air problem was under State jurisdiction. In October 1979, the State intervened in a petition for appeal with Kennecott in U.S. Ninth District Court. Smelter operations resumed in September following Governor List's emergency order authorizing such actions.

In 1978, Duvall Corp. began phasing out copper operations at Battle Mountain and initiated gold operations nearby. The company constructed a $4.5 million plant for solvent extraction of gold; it will also produce about 20 tons of cathode copper per day. Duval also experienced a 111-day strike, the first in its history. The strike ended on January 10, 1979.

Operation of the Houston Oil and Minerals Corp. gold-silver Con-Imperial pit in the legendary Comstock lode resulted in controversy. In the latter part of 1979, Lyon County commissioners were drafting mining ordinances intended to slow growth of

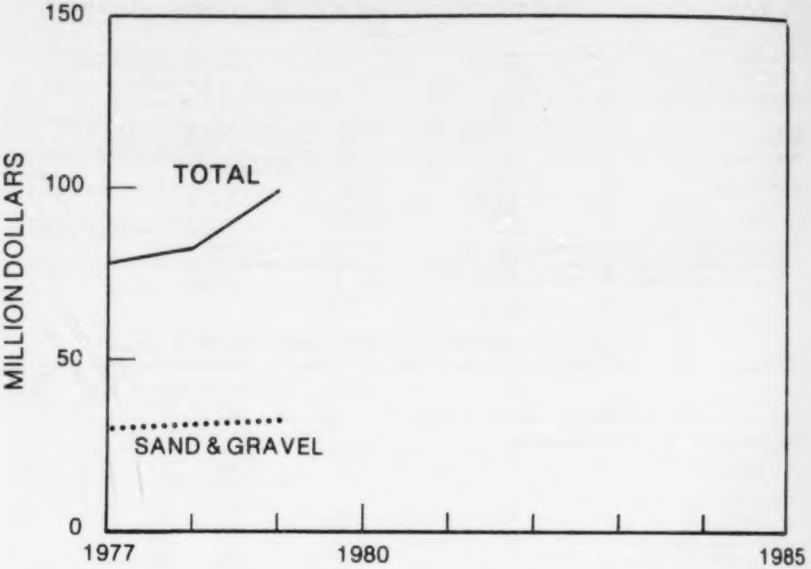

Figure 1.—Value of gold and total value of nonfuel mineral production in Nevada.

the Con-Imperial pit and protect historic houses and landmarks. Late in 1978, the company obtained the necessary State permits to operate a gold processing plant near Manhattan in Nye County. The plant will employ 60 people.

Late in 1979, Anaconda announced its decision to begin construction on a mining and milling complex to treat molybdenum ore in Nye County about 20 miles northwest of Tonapah. Development costs will approach $22 million, and the project will employ nearly 400 people. Estimated life of the mine and open pit operation is 20 years.

Resumption of large-scale tungsten mining near Imlay, in Humboldt County, was announced by Utah International in 1979. The company submitted an application to the State for permission to construct the $50 million facility.

Drilling exploration for metals and nonmetals continued at an alltime high for both years. The principal metal ores involved were gold, silver, tungsten, and molybdenum; barite, gypsum, and clay were the principal nonmetallics. Several exploration companies are reevaluating and drilling in and along the Roberts Mountain thrust fault. This mineralized zone in the fault system extends from the southwest to the northwest in north-central Nevada. Freeport Minerals Co. announced in April 1978, the discovery of a substantial gold deposit in Jerritt and Marlboro Canyons, within the Humboldt National Forest in Elko County. This deposit is significant; the company staked claims covering 42 square miles. A company called Freeport Gold Co., a subsidiary of Freeport Minerals and FMC, was formed to continue evaluation of the property and to be the operator. In late 1979, environmental baseline studies commenced for a draft environmental impact statement on the mine. Under an option agreement, Freeport was also exploring a block of claims of the Owyhee Syndicate, near Tuscarora. Geochemical surveys and rotary drilling indicate that measurable gold values are present over much of the area.

Amselco Minerals, Inc., a wholly owned U.S. subsidiary of Selection Trust Ltd. of London, anounced a major gold discovery about 60 miles northwest of Ely in White Pine County. The project, a 50-50 joint venture with Occidental Minerals Corp., has delineated 50 million tons of material averaging 0.11 ounce gold per ton. Known as Alligator Ridge, the property is being continuously evaluated.

Silver King Mines actively engaged in exploration and made numerous announcements on properties it controls. In early 1978, the company signed an agreement with Gulf Oil Corp. giving Gulf 51% interest in the Ward properties. If the properties go into production, Gulf will be the operator with Silver King, either entering into a joint venture or accepting a portion of the proceeds. The company's East Hamilton property in White Pine County, with approximately 250,000 tons of 6.3 ounces per ton silver, was leased to Treasure Hill Exploration of Las Vegas. In 1979, the State's Division of Environmental Protection issued a permit to Silver King to operate a crusher-concentrator in the Taylor mining district near Ely. The concentrator will have a capacity of 1,200 tons per day.

A three-phase program to reactivate the former silver producing area near Austin, Lander County, has been undertaken by Argus Resources, Inc.

NRD Mining is conducting a two-phase exploration program to evaluate a tungsten deposit about 40 miles southeast of Fallon in Churchill County.

In the nonmetallic sector, Sierra Chemical Co. of Reno activated a burnt lime plant at Casselton, Lincoln County, in March 1978. Production averages 200 tons per day. The company is marketing primarily in Utah, but also in California and Nevada. The Kerr-McGee Chemical Corp. in Henderson, sole United States producer of boron trichloride, announced plans in November 1978, to increase production by 200,000 pounds per year. Boron trichloride is used in the manufacture of boron filament, a lightweight and very strong material used as a replacement or reinforcement for metal. The military aircraft industry remains a major boron filament user.

In early 1979, a small barite mine, the Barst, was opened by Milchem, Inc., in the Battle Mountain area.

Imco Services Co. acquired necessary permits from the State Department of Conservation and Natural Resources to operate a barite dryer in its barite grinding mill at Mountain Springs, Battle Mountain.

Nevada Cement Co. eliminated a dust problem at a slurry pond near its plant in Fernley. The inactive 60-acre pond was leveled and covered with soil which was seeded and watered to establish turf. A new technology has enabled the firm to utilize the waste dust that previously was deposited in the pond in the manufacture of cement.

Gulf Resources and Chemical Corp. exercised its options to acquire Industrial Mineral Ventures, Inc., a small company in the developmental stage, which is engaged in mining and processing specialty clay and drilling muds. The newly acquired company has large reserves of bentonite, saponite, calcium carbonate, and hectorite on the California-Nevada border in Nye County.

In November 1979, Basic, Inc., announced plans for major capacity expansion of its chemical-grade magnesium oxide plant in Nye County. With the addition of a Herreshoff roasting furnace at its Babbs facility, the $5 million program will generate an additional 35,000 tons of magnesium oxide annually, beginning in 1981.

Legislation and Government Programs.—The 60th session of the Nevada State Legislature (1979) was involved with many diverse mineral issues. Of primary importance to the State was a $6.6 million special appropriation to the Mackay School of Mines, University of Nevada, Reno, for remodeling the existing Mackay building and constructing a new facility nearby. The new construction will house offices, research laboratories, classrooms, and an auditorium. These additions will greatly assist the school in maintaining engineering accreditation. The legislature passed a bill which revised the criminal penalty for filing false documents, including mining claim information. A bill passed in the State legislature, the so called "Sagebrush Rebellion" legislation, may have significant impact on other Western States. A bill supported by the State's mineral industry was enacted, which would permit annualization of costs relating to assessmment and taxation of net proceeds of mines.

The State Department of Taxation passed new regulations whereby net proceeds of mine taxes will be expanded to cover sand and gravel, pumice, and stone. Presently, sand and gravel producers are exempt from the tax except when the materials are used to produce cement. The department has advised the State Tax Commissioner that such exemptions are against the State Constitution and Statutes.

Several Federal land use plans and policies may have significant impact on the State's mineral resources. These are: (1) Bureau of Land Management (BLM) wilderness area review, as dictated by the Federal Land Policy and Management Act (1976); (2) Forest Service RARE II program; and (3) proposed deployment of the MX missile sites. Under the BLM program, about 4.2 million acres were proposed as wilderness study areas; only study results and the U.S. Congress will determine how much of this land becomes wilderness. BLM also called for elimination of 11.4 million acres from further wilderness consideration.

The Forest Service, in a final environmental impact statement, identified 65 separate roadless areas in Nevada totaling nearly 2.1 million acres. Of these acres, 484,175 were identified as having wilderness characteristics, 392,926 acres were held for further study, and 1,183,504 acres were classified as nonwilderness. Final decisions on disposition rest with Congress.

The proposed deployment of MX missile sites may impinge on extraction and transporation of mineral products. The draft environmental impact statement, slated to be released in mid-1980, will contain proposed land withdrawal information and resource use statistics.

At the end of 1979, about 100,000 mining claims had been registered with BLM in accordance with the Federal Land Policy and Management Act. Approximately 60% were new and did not exist prior to registration.

During the period 1978-79, the University of Nevada, Reno, was one of 31 schools and universities nationwide which were designated by the Secretary of the Interior as a State Mining and Mineral Resources and Research Institute pursuant to Title III of Public Law 95-87 (the Surface Mining Control and Reclamation Act of 1977).

The Federal Bureau of Mines completed its field studies on the Goshute Indian Reservation in September 1978, and began studies on the Pyramid Lake Indian Reservation near Reno. The Bureau also conducted field investigation on BLM lands in the Virgin Mountain area. Sample analyses indicate a possible tungsten resource. A mineral resource appraisal on the Charles Sheldon Antelope Range, Humboldt County, was released (open file) in May 1979.

U.S. Geological Survey had numerous mineral resource-oriented projects underway in Nevada. The most important was the CUSMAP study (Conterminous United States Mineral Resources Assessmment) of the Walker Lake 1° by 2° quadrangle. More than 30 professionals were involved.

The Nevada Bureau of Mines and Geology had many mineral-related projects in progress. Geological mapping was underway in th Camp Douglas and Moho Mountain quadrangles (Mineral County), Danville quadrangle (Nye County), and Sutcliffe quadrangle (Washoe County). Statewide studies are being made on barite, fluorite, mercury, molybdenum, and tungsten; the fluorspar report was released in 1979.

Employment.—Mineral industry employment exceeded an estimated 6,600 at the end of 1979. More than 2,600 were directly employed in the metal mining sector. Total mining employment rose an estimated 20% from August 1978, to December 1979.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Barite.—Production of primary barite sold or used by Nevada producers increased in 1978, compared with that of 1977, and remained constant in 1979. Barite production in the State had nearly doubled since 1976, as the domestic markets for ground and crushed barite kept expanding. Nevada ranked first in the Nation in 1979 in barite production, producing nearly 72% of total output.

Cement.—Output from the Nevada Cement Co.'s plant at Fernley, Lyon County, rose in 1978, compared with that of 1977; production in 1979 fell below that recorded in 1977-78. During 1978, the company eliminated a blowing dust problem from an inactive slurry pond east of the plant.

Clays.—Clay production in 1979 rose sevenfold from that recorded in 1977; value received increased 10 times for the same period. Output of bentonite showed the largest increase in both tonnage and value. Centex Corp. and Industrial Mineral Ventures were the State's largest producers.

Diatomite.—Production for 1978-79 remained fairly level with that of 1977, while the value of processed material rose. Eagle Picher Industries, Inc., continued to be the largest Nevada producer, followed by the United Sierra Div. of Cyprus Mines (Standard Oil Co. of Indiana), and Grefco, Inc. Five deposits were mined.

In 1979, Eagle-Picher began construction of an additional facility to manufacture diatomaceous earth products. The new plant, in Storey County, will enable the company to increase production of materials for use as oil absorbents, fertilizer coatings, and general extenders and fillers.

Fluorspar.—Metallurgical grade fluorspar was produced at the J. Irving Crowell (Daisy) Mine, Nye County. Production was constant for both years, although value received for 1979 was double that of 1978. No ceramic grade fluorspar was produced in either year.

Gem Stones.—Precious and semiprecious gem stones, especially turquoise, continued to be in demand in 1978-79. Accurate data on output were not available. Turquoise was known to have been produced from deposits in Lander, Churchill, Mineral, and Nye Counties, while opal was produced in Humboldt County.

Gypsum.—Crude gypsum was produced in Clark, Lyon, and Pershing Counties during both years. More than 50% of the State's 1978 output came from two producers, the Flintkote Co. and Pacific Coast Building Products, Inc., in Clark County. These two firms also accounted for the bulk of the State's calcined gypsum production. Operations in Nevada produced in excess of 9% of total U.S. output in 1978.

Lime.—Lime production increased in 1978 and again in 1979, compared with that of 1977. United States Lime, a division of the Flintkote Co., operated two plants in Clark County and accounted for most of the State's output. Sierra Chemicals Co. produced a limited quantity of lime in Lincoln County during 1978.

Lithium Compounds.—Foote Mineral Co.'s Silver Park facility continued to be the State's only producer of lithium compounds in 1978-79. Production remained fairly constant for both years; value received rose about 10% over the same period. The major end use continued to be as a cell additive in aluminum making.

Magnesite and Brucite.—Basic, Inc., remained the Nation's only magnesite producer for 1978-79. Annual production the past 3 years (1977-79) has increased slightly. There was no brucite mined during 1978-79.

Perlite.—Crude perlite sales in 1978-79 were about the same as those in 1977. Two mines produced, one each in Lincoln and Pershing Counties. The entire output from United States Gypsum's operation in Pershing County was consumed at its plant in Washoe County in making expanded perlite for use as a plaster aggregate.

Pumice.—Nevada's pumice industry continued to increase through 1978-79; production rose by approximately 6% per year, while value increased substantially more. The State's largest producer in 1979 was Rilite Aggregate Co., Washoe County, whose entire production was used as concrete aggregate. Other producers were Savage Construction Co., Carson City County; and Cind-R-Lite Co., Nye County. Pumice material from these operations was also used in road construction, landscaping, and roofing.

Salt.—Huck Salt Co. was the sole producer of salt in 1978-79. From its operation in Churchill County, production was constant for both years.

Sand and Gravel.—Sand and gravel production increased slightly in 1978 and again in 1979. Operations in Clark and Washoe Counties accounted for the bulk of the State's output. A total of 94 quarries were worked in 1978.

Stone.—Eleven companies produced crushed stone from 21 quarries in 1978. The Flintkote Co. and Nevada Cement Co. accounted for the bulk of the output. Most of the stone produced was limestone for use in cement and lime manufacture. For 1978, nearly 90% of the output came from Lyon and Clark Counties. No dimension stone was produced in either 1978 or 1979.

METALS

Antimony.—No activity was reported from any Nevada antimony mine or processor during 1978-79.

Copper.—Copper output decreased dramatically in 1978-79, compared with that of 1977. It fell from 67,000 short tons in 1977 to less than 1,000 short tons in 1979.

The Anaconda Co. in Lyon and Elko Counties ceased operations in July 1978, while Kennecott Corp., White Pine County, and Duval Corp., Lander County, drastically cut production. Duval subsequently began mining gold ore from an adjacent area near Battle Mountain. Nearly all of the State's 1979 copper output came from Du-

Table 4.—Nevada: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,543	$8,451	$2.39	3,859	$9,970	$2.58	4,377	$10,002	$2.29
Plaster and gunite sands	NA	NA	NA	W	W	W	W	W	W
Concrete products	272	648	2.39	W	W	W	W	W	W
Asphaltic concrete	1,345	2,738	2.04	1,494	3,581	2.40	1,803	4,248	2.36
Roadbase and coverings	3,243	5,433	1.68	2,730	5,111	1.87	2,813	4,467	1.59
Fill	1,454	2,098	1.44	1,339	2,146	1.60	1,041	1,671	1.61
Snow and ice control	NA	NA	NA	8	12	1.52	46	111	2.40
Other uses	47	178	3.77	--	--	--	--	--	--
Total[1] or average	9,904	19,542	1.97	10,040	22,620	2.25	10,498	21,387	2.04

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Table 5.—Nevada: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	2,992	$6,436	$2.15	3,933	$9,043	$2.30	3,229	$7,735	$2.40
Gravel	6,912	13,105	1.09	6,102	13,579	2.23	7,260	13,651	1.88
Total[1] or average	9,904	19,542	1.97	10,040	22,620	2.25	10,498	21,387	2.04
Industrial sand	281	1,630	5.80	W	W	W	W	W	W
Grand total	10,185	21,172	2.08	W	W	W	W	W	W

W Withheld to avoid disclosing company proprietary data.

[1] Data may not add to totals shown because of independent rounding.

Table 6.—Nevada: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate (coarse)	24	40	3	4	W	W
Macadam aggregate	96	135	14	19	--	--
Dense-graded roadbase stone	120	203	14	19	--	--
Other construction aggregate and roadstone	113	231	15	26	W	W
Riprap and jetty stone	2	3	1	3	2	8
Terrazzo and exposed aggregate	4	18	4	16	8	30
Chemicals	--	--	--	--	1	3
Bedding materials	(2)	1	--	--	--	--
Fill	27	54	--	--	--	--
Sugar refining	--	--	W	W	51	230
Other uses[3]	1,282	4,820	1,375	5,402	1,540	6,167
Total[4]	1,668	5,506	1,426	5,489	1,602	6,439

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, marble, traprock (1978-79), and miscellaneous stone.

[2] Less than 1/2 unit.

[3] Includes stone used for poultry grit and mineral food, railroad ballast, cement manufacture, lime manufacture, flux stone, glass manufacture (1978-79), unspecified uses, and uses indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

val's Copper Canyon pit.

In 1979, Kennecott began engineering feasibility studies on recovering copper from old tailings at McGill; the engineering work contract was awarded to Pullman Torkelson Co. of Salt Lake City, Utah.

Gold.—Nevada led all States in gold production in 1977; it was second in 1978, and fell to third in 1979. The State produced nearly 26% of the Nation's newly mined output in 1978 and 22% in 1979. The Carlin Mine, Eureka County, continued to be the State's largest producer. Production for both years was centered in Elko, Eureka, Lander, Lincoln, Nye, Storey, and White Pine Counties. Placer gold recovery was insignificant. About 10 heap-leach cyanidation plants operated in the State, producing precious metals.

Dramatic price increases over the past 2 years have spurred gold exploration activity to an alltime high in terms of expenditures. In April 1978, Freeport Minerals Co. announced the discovery of a substantial gold deposit in Jerritt Canyon, Elko County. Anomalous values have been located over a 42-square-mile area. Pinson Mining Co., a syndicate of four Canadian mining firms, announced the Pinson and Preble gold properties, Humboldt County, will be in production in 1980, at a cost of $14 million.

Iron Ore.—Output in 1979 increased over that reported in 1977-78; value for 1979 nearly doubled that for 1977. Direct shipping ore accounted for 88% of total mine production. All 1979 shipping-grade ores were produced by the Nevada Barth Corp. (Eureka County), and Cooney Bros. (Pershing County). Standard Slag Co. concentrated 21,000 long tons of iron ore from its Stakes iron property in Nye County.

Lead.—Production in 1978 showed a small decrease compared with that of 1977, while 1979 output fell significantly. This

Table 7.—Nevada: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing		Material sold or treated[1] (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1977, total	22	1	16,738,157	324,003	$48,052,886	738,402	$3,411,418
1978:							
Churchill	1	--	57	--	--	1,037	5,600
Elko	3	--	97,057	11,001	2,129,243	W	W
Eureka	4	--	773,671	148,404	28,723,595	4,926	26,601
Lander	2	--	710,339	26,706	5,168,946	199,220	1,075,788
Lyon	1	--	1,766,831	--	--	--	--
Undistributed[2]	9	2	3,109,113	74,784	14,474,443	598,704	3,233,000
Total	20	1	[3]6,457,067	260,895	50,496,227	803,887	4,340,989
1979, total[4]	16	2	4,971,644	199,960	61,487,704	528,588	5,862,042

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1977, total	60,837	$89,593,302	674	$456,099	1,517	$1,150,186	$142,663,891
1978:							
Churchill	--	--	([5])	83	--	--	5,683
Elko	11	15,891	W	W	W	W	2,145,533
Eureka	--	--	([5])	345	([5])	320	28,750,861
Lander	4,861	7,125,868	7	4,975	([5])	113	13,375,690
Lyon	8,010	11,743,911	--	--	--	--	11,743,911
Undistributed[2]	7,571	11,100,243	646	480,020	1,370	936,494	30,223,801
Total	20,453	29,985,913	653	485,423	[3]1,371	936,927	86,245,479
1979, total[4]	W	W	24	28,159	W	W	72,570,249

W Withheld to avoid disclosing company proprietary data; included in "Undistributed" and/or "Total."

[1] Does not include gravel washed.

[2] Includes Douglas, Lincoln, Nye, Pershing, and Storey Counties combined to avoid disclosing company proprietary data, and items indicated by symbol W.

[3] Data do not add to total shown because of independent rounding.

[4] Includes Churchill, Elko, Eureka, Lander, Lincoln, Lyon, Nye, Pershing, Storey, and Washoe Counties combined to avoid disclosing company proprietary data.

[5] Less that 1/2 unit.

was due to Bunker Hill Co.'s closure in 1978 of the Pan American Mine in Lincoln County. Lesser quantities of lead came from small operations in Churchill, Elko, Eureka, and Lander Counties. In 1979, the prominent producer was Gold Creek Silver Mines in Elko County.

Mercury.—Production fell slightly in 1978, compared with that of 1977, but rose in 1979 to surpass the 1977 level in both quantity and value. Nevada remained the leading mercury mining State for both years, producing nearly 99% of the Nation's metal. The McDermitt Mine, Humboldt County, was the United States largest single producer; other production in Nevada was as a byproduct from the Carlin Gold Mining Co. in Eureka County.

Molybdenum.—All Nevada molybdenum production came as a byproduct from Kennecott Copper Corp.'s McGill copper concentrator. Production fell dramatically in 1978, compared with that of 1977; only stocks were shipped in 1979. Because of closure of Kennecott's mining facilities in White Pine County, molybdenum production in 1979 was only a third of that for 1978. In 1979, the Anaconda Co. announced plans for a mining and milling complex (Hall property) for molybdenum ore in Nye County, about 20 miles northwest of Tonopah.

Silver.—Silver production rose slightly in 1978, compared with that of 1977, but in 1979 dropped below the 1977 level. Value rose significantly in 1979 because of rapid price increases in the last half of the year. There were 14 producers in 1978, and 11 in 1979. West Coast Oil and Gas Corp.'s Gooseberry Mine, Storey County, was the leading producer both years. Notable production also came from Duval's Copper Canyon and Bunker Hill's Pan American Mines (1978).

Events in 1979 should, in the future, cause Nevada to again be prominent in

Table 8.—Nevada: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by class of ore or other source material

Source	Number of mines[1]	Material sold or treated[2] (thousand metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
1978							
Lode ore:							
Gold[3]	10	2,352	[4]228,998	[4]432,349	([5])	([5])	([6])
Gold-silver and silver[4]	4	1	18	11,768	([5])	1	1
Copper[3] and lead-zinc[6]	4	4,100	31,879	359,770	17,740	652	1,370
Total	18	6,453	260,895	803,887	17,740	653	1,371
Other lode material:							
Copper precipitates	4	4	--	--	2,713	--	--
Total lode material[7]	20	6,457	260,895	803,887	20,453	653	1,371
Placer	1	--	W	W	--	--	--
Grand total	21	6,457	260,895	803,887	20,453	653	1,371
1979							
Lode ore:							
Gold[3]	9	4,970	199,866	522,507	W	([5])	W
Gold-silver and silver[4]	3	([5])	16	5,621	W	24	W
Copper[8]	4	1	66	460	W	([5])	W
Total[7]	16	4,972	199,948	528,588	W	24	W
Other lode material:							
Copper precipitates	3	W	--	--	W	--	--
Total lode material	16	4,972	199,948	528,588	W	24	W
Placer	2	--	12	--	--	--	--
Grand total	18	4,972	199,960	528,588	W	24	W

W Withheld to avoid disclosing company proprietary data; included with gold ore in 1978; excluded from totals in 1979.

[1] Detail will not necessarily add to totals shown because some mines produce more than one class of material.

[2] Does not include gravel washed.

[3] Includes material that was leached.

[4] Includes small quantity of material recovered from placer.

[5] Less than 1/2 unit.

[6] Combined to avoid disclosing company proprietary data.

[7] Data may not add to totals shown because of independent rounding.

[8] Includes copper precipitates and copper content of material leached from gold ore.

Table 9.—Nevada: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
1978					
Lode:					
Cyanidation	228,956	432,295	--	--	--
Smelting of concentrates	32,775	368,923	10,305	653	1,371
Leaching	(1)	(1)	7,301	--	--
Direct smelting of:					
Ore	[2]164	[2]2,669	135	1	(3)
Copper precipitates	--	--	2,713	--	--
Total lode material[4]	260,895	803,887	20,453	653	1,371
Placer	W	W	--	--	--
Grand total	260,895	803,887	20,453	653	1,371
1979					
Lode:					
Cyanidation	199,857	520,885	--	--	--
Smelting of concentrates	22	3,693	W	1	W
Leaching	(1)	(1)	W	--	--
Direct smelting of:					
Ore	69	4,040	W	23	W
Copper precipitates	--	--	W	--	--
Total lode material	199,948	528,588	W	24	W
Placer	12	--	--	--	--
Grand total	199,960	528,588	W	24	W

W Withheld to avoid disclosing company proprietary data; included with direct smelting of ore in 1978; excluded from totals in 1979.

[1] Included in cyanidation.

[2] Includes small quantity of material recovered from placer.

[3] Less than 1/2 unit.

[4] Data may not add to totals shown because of independent rounding.

primary silver production. Silver King Mines secured necessary permits to start a 1,200-ton-per-day open pit operation in the Taylor mining district near Ely; estimated production is 1.0 to 1.5 million ounces of silver per year. Candelaria Partners, a limited partnership between Occidental Minerals Corp. and Congon and Carey of Denver, Colo., announced plans in late 1979 to begin an 8000-ton-per-day open pit operation at the historic Candelaria mining camp, Mineral County. Total project cost is estimated to be $25 to $30 million.

Houston Oil and Minerals began stockpiling ore from the Con-Imperial Mine, Lyon County. Mill production will start in 1980.

Bar Resources, Ltd., (Canada) brought their Buckhorn project into production (November 1979) in record time—5 months. The Buckhorn, a 500-ton-per-day open pit gold-silver operation in Eureka County, should produce 14 to 16,000 ounces of gold, and 140 to 180,000 ounces of silver per year.

Tungsten.—Active tungsten producers in Nevada numbered 26 in 1978 and fell to 20 in 1979. The State's largest producer, Union Carbide's Emerson Mine in Lincoln County, accounted for a large proportion of total output. All concentrates were shipped to either Union Carbide's Pine Creek ammonium paratungstate plant, Bishop, Calif., or the tungsten carbide plant of Kennemetal, Inc., in Churchill County.

In late 1979, Utah International announced plans to open the Springer Tungsten Mine, Pershing County. A plant will be constructed at the mine site for conversion of concentrate to ammonium paratungstate at the rate of 1.6 million pounds of contained tungsten per year; proposed operational date is 1982.

Nevada ranked third in the Nation in 1979 in tungsten production.

Zinc.—Production fell somewhat in 1978, compared with that of 1977, and decreased to almost nothing in 1979. This reduction was because the State's largest producer, the Pan American Mine in Lincoln County, closed in 1978 because of depressed lead-zinc market conditions. This operation accounted for nearly all of the zinc output in 1978. Gold Creek Silver Mines was the principal producer in 1979.

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[1] State mineral specialist, Spokane, Wash.

[2] Director, Nevada Bureau of Mines and Geology, Reno, Nev.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Barite:			
FMC Corp	Box 531 Battle Mountain, NV 89820	Surface mine	Lander.
Milchem, Inc	Box 272 Battle Mountain, NV 89820	Surface mine and mill	Do.
Dresser Minerals	Box 375 Battle Mountain, NV 89820	do	Do.
IMCO Services, Inc	Box 861 Battle Mountain, NV 89820	Surface mine and mill and plant.	Do.
NL Industries, Inc	Box 1675 Houston, TX 77001	Surface mine and mill	Elko.
Standard Slag Co	Box 10477 Reno, NV 89510	do	Nye.
All Minerals, Inc	Box 63 Round Mountain, NV 89045	do	Do.
Cement:			
Nevada Cement Co.[1]	Fernley, NV 89408	Plant	Lyon.
Clays:			
Centex Corp	do	Surface mine	Pershing.
Industrial Minerals Ventures	Box 237 Lothrop Wells, NV 89020	Surface mine and mill	Nye.
Western Talc Co	Box 398 Beatty, NV 89003	Mine	Do.
Copper:			
The Anaconda Co	Box 1000 Weed Height, NV 89443	Surface mine	Lyon.
	Box 65 Wendover, UT 84083	Open pit mine	Elko.
Duval Corp.[2]	Box 451 Battle Mountain, NV 89820	Surface mine	Lander.
Kennecott Copper Corp.[3]	McGill, NV 89318	do	White Pine.
Diatomite:			
Eagle-Picher Industries, Inc	Box 1869 Reno, NV 89505	Surface mine and plant	Pershing and Storey.
Cyprus Industrial Minerals Co	Box 455 Fernley, NV 89408	do	Churchill.
Fluorspar:			
J. Irving Crowell, Jr	Box 96 Beatty, NV 89003	Underground mine	Nye.
Gold:			
Carlin Gold Mining Co.[4]	Box 979 Carlin, NV 89822	Surface mine	Elko.
Idaho Mining Co	Box 328 Eureka, NV 89316	do	Eureka.
Smokey Valley Mining Co	Box 480 Round Mountain, NV 89045	do	Nye.
Standard Slag Co	Box 97 Pioche, NV 89043	do	Lincoln.
Gypsum:			
The Flintkote Co.[5]	Box 2900 Las Vegas, NV 89101	Surface mine and plant	Clark.
Division Pabco, Inc	Box 14186 Las Vegas, NV 89114	do	Do.
United States Gypsum Co.[6]	Empire, NV 89405	do	Pershing.
Iron ore:			
Nevada Barth Corp	Box 425 Carlin, NV 89822	Surface mine	Eureka.
Cooney Bros	Box 568 Lovelock, NV 89419	do	Pershing.
Lead:			
Bunker Hill Co.[7]	Box 276 Pioche, NV 89043	Mine	Lincoln.
Lime:			
The Flintkote Co	Box 3598 North Las Vegas, NV 89030	Surface mine and plant	Clark.
Sierra Chemicals Co	Box 67 Pioche, NV 89043	do	Lincoln.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Lithium:			
Foote Mineral Co	Silverpeak, NV 89047	Dry lake brines	Esmeralda.
Magnesite:			
Basic, Inc	Box 4 Gabbs, NV 89409	Surface mine	Nye.
Manganese:			
Kerr-McGee Corp	1101 McGee Tower Oklahoma City, OK 72301	Plant	Clark.
Mercury:			
McDermitt Mine	Box 101 McDermitt, NV 89421	Open pit mine	Humboldt.
Molybdenum:			
Kennecott Copper Corp	McGill, NV 89318	Surface mine and mill	White Pine.
Perlite:			
Dela Perlite Partnership	Caliente, NV 89008	Mine	Lincoln.
Pumice:			
Rilite Aggregate Co	Box 5665 Reno, NV 89503	Surface mine	Washoe.
Cind-R-Lite Block Co	3333 Cinder Lane Las Vegas, NV 89103	Open pit mine	Nye.
Savage Construction	Box 970 Carson City, NV 89701	do	Carson City.
Salt:			
Huck Salt Co	Route 2, Box 32 Fallon, NV 89406	Solar evaporation plant.	Churchill.
Sand and gravel:			
Robert L. Helms Construction & Development.	Drawer 608 Sparks, NV 89431	Pit	Washoe.
	Box 1206 Tonopah, NV 89049	Pit	Esmeralda.
Nevada Aggregates and Asphalt	Box 7424 Reno, NV 89502	Pit	Washoe.
Nevada Rock & Sand Co	Box 2775 Huntridge Sta. Las Vegas, NV 89101	Pit	Clark.
Wells-Cargo, Inc.[8]	Box 14037 Las Vegas, NV 89114	Pit	Do..
W.M.K. Transit Mix, Inc	1606 Industrial Rd. Las Vegas, NV 89102	Pit	Do.
Diamond Construction Co	4020 East Cheyenne Ave. Las Vegas, NV 89030	Pit	Do.
Southern Nevada Paving, Inc	3555 Polaris Las Vegas, NV 89101	Pit	Do.
W.M.C. Engineering	Box 1301 Elko, NV 89801	Pit	Elko.
Hess Rock Products Co	Route 1, McCarran Ranch Sparks, NV 89431	Pit	Washoe.
Stone:			
The Flintkote Co	Box 3598 North Las Vegas, NV 89030	Surface mine and plant	Clark.
Nevada Cement Co	Fernley, NV 89408	do	Lyon.
Talc:			
Lloyd D. Rosenburg	Box 127 Olancha, CA 93549	Surface mine	Esmeralda.
Union Carbide Corp	Box 307 Alamo, NV 89001	Mine and mill	Lincoln.
Zinc:			
Bunker Hill Co	Box 276 Pioche, NV 89043	do	Do.
Gold Creek Silver Mines	Elko, NV 89801	Mine	Elko.

[1] Also gold and silver.
[2] Also gold, silver, and lead.
[3] Also gold and silver.
[4] Also mercury.
[5] Also lime.
[6] Also perlite.
[7] Also silver.
[8] Also stone.

The Mineral Industry of New Hampshire

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the New Hampshire Department of Resources and Economic Development for collecting information on all nonfuel minerals.

By Doss H. White, Jr.[1] and Robert I. Davis[2]

The value of New Hampshire's nonfuel mineral production in 1978 and 1979 was $23.2 million and $23.3, respectively. Sand and gravel and stone were the major mineral commodities produced during the 1978-79 period.

Trends and Developments.—Although the number of industrial workers active in basic mineral extraction was small, approximately 20% of the State's work force was engaged in mineral-dependent construction or in the manufacture of products that were either derived from mineral raw materials or were heavily dependent on these raw materials.

New Hampshire continued to be a net importer of mineral commodities. Petroleum products and liquefied natural gas, salt, gypsum, mica, cement, lime, soapstone, and crude perlite were all imported for consumption or for the manufacture of other products of higher value. Most of the State's imported mineral commodities passed through the port of Portsmouth.

Table 1.—Nonfuel mineral production in New Hampshire[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Sand and gravel ---- thousand short tons--	6,835	$13,888	7,859	$16,295	7,086	$15,301
Stone:						
Crushed ------------------do----	719	2,036	914	2,634	866	2,172
Dimension ----------------do----	73	4,650	61	4,077	86	5,774
Combined value of other nonmetals--------	XX	127	XX	161	XX	11
Total ------------------------	XX	20,701	XX	23,167	XX	23,258

XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in New Hampshire, by county

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Belknap	$1,131	$1,572	Sand and gravel.
Carroll	1,896	2,279	Do.
Cheshire	1,057	1,173	Do.
Coos	703	1,030	Do.
Grafton	W	W	Sand and gravel, stone.
Hillsborough	W	6,588	Do.
Merrimack	W	W	Stone, sand and gravel.
Rockingham	W	2,542	Sand and gravel, stone.
Strafford	W	W	Sand and gravel, clays.
Sullivan	528	631	Sand and gravel.
Undistributed[1]	15,386	7,355	
Total	[2]20,701	23,167	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes gem stones and values indicated by symbol W.

[2] Data do not add to total shown because of independent rounding.

Table 3.—Indicators of New Hampshire business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	410.0	427.0	444.0	+4.0
Unemployment	do	24.0	16.0	14.0	-12.5
Employment (nonagricultural):					
Mining	do	.4	.4	.4	--
Manufacturing	do	101.4	109.8	116.0	+5.6
Contract construction	do	17.0	18.8	20.7	+10.1
Transportation and public utilities	do	12.3	13.0	13.5	+3.8
Wholesale and retail trade	do	73.7	80.2	83.2	+3.7
Finance, insurance, real estate	do	16.2	17.4	18.7	+7.5
Services	do	62.3	65.3	67.7	+3.7
Government	do	53.8	56.4	57.2	+2.3
Total nonagricultural employment	do	337.1	361.3	377.4	+4.5
Personal income:					
Total	millions	$5,644	$6,427	$7,301	+13.6
Per capita		$6,639	$7,378	$8,231	+11.6
Construction activity:					
Number of private and public residential units authorized		6,702	117,162	6,891	-3.8
Value of nonresidential construction	millions	$67.9	$67.7	$80.2	+18.5
Value of State road contract awards	do	$60.0	NA	$30.0	--
Shipments of portland and masonry cement to and within the State	thousand short tons	276	347	318	-8.4
Nonfuel mineral production value:					
Total crude mineral value	millions	$20.7	$23.2	$23.3	+.4
Value per capita, resident population		$24	$27	$26	-3.7
Value per square mile		$2,225	$2,491	$2,500	+.4

[p] Preliminary. NA Not available.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Of all the New England States, New Hampshire during the 1978-79 biennium enjoyed one of the highest growth rates in terms of its economy and population and also had one of the lowest unemployment rates per capita. State officials have been concerned, however, about finding ways to control growth for social and environmental reasons. One approach, controlling land use, had adversely affected the State's mining industry.

In numerous areas of the State, commercial gravel deposits have been depleted, preempted for other land uses, or restricted by environmental regulations that forbid mining or make it uneconomical. An increasing number of local zoning or planning boards was denying requests for mining permits. In some cases, mining companies had to undergo lengthy and costly court appeals in attempts to obtain necessary permits; thus, prices of basic construction materials have risen. Sometimes, shifts by the consumer to more costly crushed stone products occurred.

The New Hampshire Dredge and Fill Board denied an application for a 2-day experiment on the recovery of diatomaceous earth from Lake Umbagog in northern New Hampshire. The mining experiment was designed to demonstrate that earth could be recovered from the lake without adverse environmental effects.

Wilderness designation was proposed for 168,000 acres of the White Mountain National Forest by the U.S. Department of Agriculture. Such a designation would prohibit mining, timber cutting, and most commercial development. The Society for the Protection of New Hampshire Forests, one of the State's largest conservation organizations, recommended that "substantially less acreage" be classified as wilderness and supported a multiple-use concept for much of the acreage proposed for designation as a wilderness area.

In 1978, the New Hampshire Legislature passed a coastal zone management bill, but it was vetoed by the Governor. During the 1979 legislative session, the House voted to reject establishment of a State program to manage the State's 17 miles of coastline. However, an amended version of the coastal zone management legislation was introduced during the latter part of the session. Under Federal law, the State will lose $90,000 in Federal funds to assist communities in planning future development if such a bill is not passed.

Legislation and Government Programs.—A three-bill package introduced during the 1979 session of the Legislature was under close scrutiny by the State's mining industry and environmental organizations. Bill H-425, designed to regulate exploration for and the mining of minerals other than gravel, was signed into law. This law requires a State-issued permit for exploration, and, if minable minerals are discovered, an additional mining license from the State. To obtain the State license, local authorities must be notified; public hearings must be arranged; and complete mining, blasting, and reclamation plans must be filed. A company is required to post a performance bond to guarantee compliance of the mining operation with the terms of the permit. Operators of existing mines are exempt from the law if they applied for exemption within a year after the law was passed.

A second bill, H-661, for regulating gravel extraction, was also signed into law by the Governor. This law requires operators to obtain a permit before mining and to submit mining and reclamation plans to local authorities. Also, disturbed land must be reclaimed upon the termination of mining. This legislation was supported by existing gravel companies, which favored local control of gravel extraction over potentially more restrictive State control.

A third bill, which would have imposed a 5% tax on minerals produced in the State, was defeated. The bill's sponsor estimated that the tax would have raised $1 million per year for the State's general fund. Mineral industry representatives testified against the proposal, arguing that a before-profits tax would close some mining operations and would discourage mineral exploration in New Hampshire.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—New Hampshire had no cement plants. During 1978 and 1979, most of the cement used in the State's construction industry was produced in Maine and transported into the State by rail.

Clays.—One firm, the Kane-Gonic Brick Corp., mined clay in Strafford County to produce common brick. Clay and brick production during both 1978 and 1979 was greater than that reported in 1977.

Gem Stones.—In the State's mineral economy, gem stones and mineral specimens play a small but important part. Pegmatite minerals, fluorite, amazonite, topaz, and smoky quartz were some of the specimens collected by rockhounds and mineral dealers.

Gypsum.—The Portsmouth plant complex of National Gypsum Co. calcined gypsum obtained from the company's subsidiary, National Gypsum Co. of Canada, located at Milton, New Brunswick, Canada. National Gypsum is one of two active gypsum calciners in New England. (The other, United States Gypsum Co., operates in Massachusetts.) Gypsum imports enter New Hampshire through the port of Portsmouth.

Lime.—Calcium products, lime, and ground limestone were imported into New Hampshire from other New England States; the State had no active lime operation.

Major lime uses were in construction and pollution control.

Mica.—The Macallen Co., Inc., a division of Essex International, Inc., at Newmarket, and Concord Mica Corp., in Penacook, produced fabricated mica products from raw materials imported primarily from foreign sources. The State was once an important source of mica for New England's industries, but none of the State's mica operations have been active for many years.

Perlite.—Expanded perlite was produced at the National Gypsum Co.'s facility at Portsmouth in Rockingham County. The raw material was shipped by rail from mines in New Mexico.

Sand and Gravel.—Sand and gravel, the major mineral commodity produced in the State in 1978 and 1979 in terms of tonnage and value, was obtained from surface mines in all of the State's 10 counties. However, the tremendous demand for gravel for road building and maintenance, as well as for concrete aggregate, had seriously depleted known deposits that were usable without processing. Many community gravel pits had less than 2 years' supply. Deposits of off-size, poorly sorted gravel existed in some areas, but this gravel must be crushed to size before use, which increases its cost. Some firms had begun to crush rock to produce gravel-size aggregate. However, the drilling and blasting required before crushing also raises the cost. The Department of Resources and Economic Development, aware of the growing aggregate reserve problem, employed a geological consulting firm to inventory sand and gravel deposits and specify areas suitable for crushed stone operations.

Table 4.—New Hampshire: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	2,436	$5,540	$2.27	2,757	$6,515	$2.36	2,473	$5,985	$2.42
Plaster and gunite sands	NA	NA	NA	W	W	W	43	114	2.66
Concrete products	283	714	2.53	245	630	2.57	133	388	2.92
Asphaltic concrete	1,450	3,053	2.11	1,649	3,508	2.13	1,580	3,699	2.34
Roadbase and coverings	1,503	2,877	1.91	1,690	3,224	1.91	1,292	2,563	1.98
Fill	816	1,080	1.32	796	1,015	1.27	731	968	1.32
Snow and ice control	NA	NA	NA	185	295	1.59	206	277	1.34
Railroad ballast	W	W	W	18	18	1.00	--	--	--
Other uses	348	624	1.81	517	1,090	2.86	629	1,307	2.08
Total[1] or average	6,835	13,888	2.03	7,859	16,296	2.07	7,086	15,301	2.16

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."
[1]Data may not add to totals shown because of independent rounding.

Table 5.—New Hampshire: Construction sand and gravel sold or used by producers

	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	2,397	$4,445	$1.85	3,361	$6,469	$1.92	3,129	$6,015	$1.92
Gravel	4,438	9,443	2.13	4,497	9,826	2.18	3,957	9,286	2.35
Total[1] or average	6,835	13,888	2.03	7,859	16,295	2.07	7,086	15,301	2.16

[1]Data may not add to totals shown because of independent rounding.

Soapstone.—The Woodstock Co. imported soapstone, a massive variety of talc, for the manufacture of wood-burning stoves in the Bridgewater plant.

Stone.—Crushed and dimension stone ranked second only to sand and gravel in New Hampshire's mineral production in both tonnage and value.

Crushed stone was produced in a three-county, north-south trending belt traversing the central part of the State. Two firms crushed traprock in Grafton and Rockingham Counties, and one firm produced crushed granite in Merrimack County.

Dimension granite quarries and fabricating plants were active in Hillsborough and Merrimack Counties. They produced curbing, dressed architectural, construction, and monumental stone. Increased demand for granite curbstone, which withstands salt applications for snow and ice removal much better than concrete, has provided increased business for the State's dimension granite producers. The State ranked second, behind Georgia, in output of dimension granite.

Table 6.—New Hampshire: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate (coarse)	[2]140	[r][2]390	166	483	153	419
Bituminous aggregate	185	512	233	639	240	660
Other construction aggregate and roadstone	261	888	374	1,184	330	859
Riprap and jetty stone	56	159	W	199	27	71
Manufactured fine aggregate (stone sand)	W	W	9	36	W	W
Other uses[3]	77	88	131	92	116	163
Total[4]	719	2,036	914	2,634	866	2,172

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes granite and traprock.

[2] Includes manufactured fine aggregate (stone sand).

[3] Includes stone used in dense-graded roadbase stone and surface treatment aggregate.

[4] Data may not add to totals shown because of independent rouding.

METALS

Several major companies reportedly were interested in the State's potential for uranium, copper, zinc, and lead, but information concerning individual company activities has not been made public.

Gold.—The dramatic increase in the price of gold resurrected interest in the old Ammonoosus Gold District in northwestern New Hampshire. Small amounts of gold were recovered by individuals panning streams in the area.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

[2] State geologist, New Hampshire Department of Resources and Economic Development, Durham, N.H.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Kane-Gonic Brick Corp	Gonic, NH 03867	Pit	Strafford.
Gypsum (calcined):			
National Gypsum Co.[1]	325 Delaware Ave. Buffalo, NY 14202	Plant	Rockingham.
Sand and gravel:			
Ralph L. Bezzell, Inc	66 School St. Merrimac, MA 01860	Pit	Do.
Alvin J. Coleman & Son, Inc	Route 16 Conway, NH 03818	Pit	Carroll.
J. J. Cronin Co.	Box 176 North Reading, MA 01864	Pit	Rockingham.
Hudson Sand & Gravel	85 Greeley St. Hudson, NH 03051	Pit	Hillsborough.
Iafolla Industries, Inc.[2]	Peverly Hill Rd. Portsmouth, NH 03801	Pit	Rockingham and Strafford.
Keene Sand & Gravel	725 Main St. Keene, NH 03431	Pit	Cheshire.
Manchester Sand, Gravel & Cement Co.[3]	Box 415 Hooksett, NH 03106	Pit	Merrimack.
New Hampshire State Public Works & Highway Dept.	85 Loudon Rd. Concord, NH 03301	Pits	Statewide.
Ossipee Aggregates Corp	Ossipee, NH 03864	Pit	Carroll.
Plourde Sand & Gravel Co.	Suncook NH 03275	Pit	Merrimack.
Ryder Concrete Inc	Milford, NH 03055	Pit	Hillsborough.
Tilton Sand & Gravel, Inc	Tilton, NH 03276	Pit	Belknap.
F. W. Whitcomb Construction Corp	Box 429 Bellows Falls, VT 05101	Pit	Cheshire.
Stone:			
Granite dimension:			
Kitledge Granite Corp.	Armory Rd. Milford, NH 03055	Quarry	Hillsborough.
Maine-New Hampshire Granite Co	North State St. Concord, NH 03301	do	Merrimack.
John Swenson Granite Co., Inc	Box 1122 Lowell, MA 01853	do	Do.
Traprock:			
Lebanon Crushed Stone Inc	Plainfield Rd. West Lebanon, NH 03784	do	Grafton.

[1] Also expanded perlite.
[2] Also traprock.
[3] Also crushed granite.

The Mineral Industry of New Jersey

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the New Jersey Division of Natural Resources, Bureau of Geology and Topography, for collecting information on all nonfuel minerals.

By William Kebblish[1]

The value of New Jersey's mineral production totaled $128 million in 1978 and $152 million in 1979. The three main minerals, in terms of value, were sand and gravel, stone, and zinc, which accounted for nearly 90% of the State's total mineral value in 1978. Leading counties, in value of mineral production, were Camden, Cumberland, Morris, Passaic, Somerset, and Sussex.

Table 1.—Nonfuel mineral production in New Jersey[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	68	$374	68	$376	67	$559
Gem stones	NA	17	NA	1	NA	1
Lime thousand short tons	W	W	17	787	W	W
Peat do	30	769	24	568	23	549
Sand and gravel do	9,697	29,327	10,430	40,840	10,781	44,682
Stone, crushed[2] do	12,993	46,621	13,192	50,181	13,950	63,174
Zinc (recoverable content of ores, etc.) metric tons	30,358	23,024	28,915	19,761	31,118	25,589
Combined value of iron ore (1977-78), magnesium compounds, marl (greensand), stone (dimension), titanium concentrate (ilmenite), and values indicated by symbol W	XX	16,928	XX	15,342	XX	17,135
Total	XX	117,060	XX	127,856	XX	151,689

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sale, or marketable production (including consumption by producers).

[2] Excludes dimension stone; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in New Jersey, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Atlantic	W	$594	Sand and gravel.
Bergen	W	W	Do.
Burlington	W	757	Do.
Camden	$1,983	2,841	Do.
Cape May	W	W	Magnesium compounds, sand and gravel.
Cumberland	W	W	Sand and gravel, clays.
Essex	W	W	Stone.
Gloucester	W	W	Greensand marl, sand and gravel.
Hudson	W	W	Stone.
Hunterdon	W	W	Do.
Mercer	W	W	Do.
Middlesex	W	W	Sand and gravel, clays.
Monmouth	464	472	Sand and gravel.
Morris	W	W	Sand and gravel, stone, iron ore.
Ocean	W	W	Ilmenite, sand and gravel.
Passaic	6,530	7,173	Stone, sand and gravel.
Somerset	19,096	20,826	Stone, clays.
Sussex	W	W	Zinc, stone, sand and gravel, lime, peat.
Union	W	1,527	Stone.
Warren	W	W	Sand and gravel, stone, peat.
Undistributed[2]	88,987	93,664	
Total	117,060	[3]127,856	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1] Salem County is not listed because no nonfuel mineral production was reported.
[2] Includes gem stones and values indicated by symbol W.
[3] Data do not add to total shown because of independent rounding.

Table 3.—Indicators of New Jersey business activity

	1977	1978[p]	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	3,367.0	3,425.0	3,538.0	+3.0
Unemployment do	316.0	246.0	245.0	-.4
Employment (nonagricultural):				
Mining do	2.9	2.5	NA	--
Manufacturing do	767.7	789.2	NA	--
Contract construction do	94.5	106.7	NA	--
Transportation and public utilities do	178.2	188.6	NA	--
Wholesale and retail trade do	637.1	665.1	NA	--
Finance, insurance, real estate do	142.9	148.3	NA	--
Services do	514.0	545.7	NA	--
Government do	503.2	521.9	NA	--
Total nonagricultural employment do	[1]2,840.6	2,968.0	NA	--
Personal income:				
Total millions	$58,112	$64,297	$71,135	+10.6
Per capita	$7,920	$8,775	$9,702	+10.6
Construction activity:				
Number of private and public residential units authorized	34,665	[2]38,163	35,137	-7.9
Value of nonresidential construction millions	$476.1	$622.3	$656.2	+5.4
Value of State road contract awards do	$250.0	$128.0	$133.4	+4.2
Shipments of portland and masonry cement to and within the State thousand short tons	1,391	1,762	1,796	+1.9
Nonfuel mineral production value:				
Total crude mineral value millions	$117.1	$127.9	$151.7	+18.6
Value per capita, resident population	$16	$17	$21	+23.5
Value per square mile	$14,939	$16,316	$19,358	+18.6

[p] Preliminary. NA Not available.
[1] Data do not add to total shown because of independent rounding.
[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

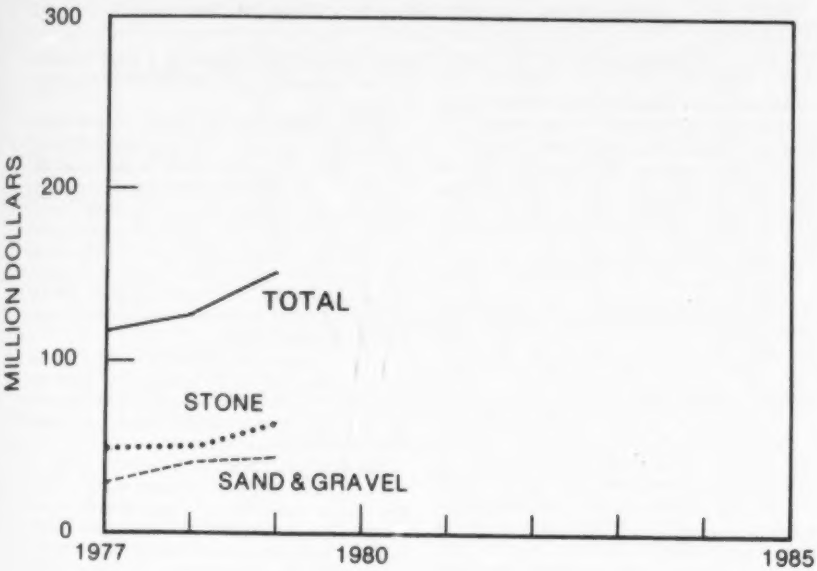

Figure 1.—Value of sand and gravel and stone, and total value of nonfuel mineral production in New Jersey.

Employment.—New Jersey's mining industry employed 2,555 workers in 1978. Sand and gravel operations accounted for 1,226 workers, or nearly 48% of the total; the stone industry accounted for 858 employees; and the metal industry accounted for 419 workers. The remaining 52 employees were in clay and shale operations, gypsum plants, and peat operations.

Legislation and Government Programs.—In early November 1978, legislation was passed establishing a Pinelands National Reserve to protect an area of approximately 970,000 acres located 30 miles east of Philadelphia and 60 miles south of New York City. No minerals are currently produced in the Pinelands, but zoning ordinances could be established to regulate mining if minerals are located. Currently, one-fifth of the Pinelands is classified as public lands. At the end of 1979, hearings were held by the Department of Environmental Protection (DEP) to clarify the Pinelands boundary.

New Jersey's coastal zone management plan, known as Bay and Ocean Shore Segment (BOSS), was approved by the Federal Government in late 1978. One part of the program concerns extraction, processing, and reclamation of minerals, including construction and industrial sand, ilmenite, and glauconite. Mining operators are required to comply with the program's standards.

In 1978-79, the Bureau of Geology and Topography made available to the public, as well as to land use planners, overlay maps showing service facilities throughout the State. Other publications pertained to pollution, wastewater management, construction projects within the coastal area, location of water wells, geodetic surveys, and mining practices.

A State program, with possible impact on the mining industry, concerns dredging of the Absecon Creek in Atlantic County. The 5-year study by DEP and Rutgers University, initiated in 1979, will determine the effects of dredging on fish, shellfish, and other marine organisms, and will seek improved methods of disposing of the dredged materials.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—New Jersey had no cement production, but shipments of portland and masonry cement into the State totaled 1.7 million short tons in 1978 and 1.8 million short tons in 1979. Most of the cement was manufactured in Pennsylvania and New York. Distribution terminals were in Jersey City, Bayonne, Elizabethport, and Newark.

Clays.—Common clay and shale, and fire clay were each produced at two operations; one operation produced both common and fire clay. Total clay production remained unchanged from 1978 to 1979, but value increased nearly 50%.

J. S. Morie & Son, Inc., produced fire clay at the Clayville Mine, Cumberland County; New Jersey Shale Brick & Tile Corp. produced common clay and shale in Somerset County; and Almasi Clay Co. produced both common clay and shale and fire clay at the Main Street Mine, Middlesex County. Common clay and shale were used for face brick and sewer pipe; fire clay was used for fire brick and block, cement, refractory mortar, and sealing.

Gem Stones.—Collectors obtained specimens in the northern part of the State. The New Street Quarry, as well as the road cuts on Route 80 near West Patterson, produced fine green prehnite and silky white pectolite. Other areas included the First Watchung Mountain near Patterson, Braens Quarry near Hawthorne, and quarries near Great Notch. The value of gem stones collected was estimated at $1,000 in 1978, and again in 1979.

Graphite (Synthetic).—Celanese Corp.'s Summit Plant, Union County, was the only producer of synthetic graphite in the State in 1979. Principal uses were for anodes, graphite shapes, crucibles, and electric motor brushes.

Greensand Marl.—Inversand Co., Gloucester County, was the only producer of greensand marl in the Nation. In 1979, production and value increased about 33%, compared with that of 1978. Greensand marl is a sand or marl containing glauconite. The product was used in water treatment and for agricultural purposes.

Gypsum.—Calcined gypsum was produced by National Gypsum Co., Burlington County, and by the Flintkote Co., Camden County. The product was used mainly in the manufacture of wallboard lath and sheeting.

Iodine.—Eight chemical and pharmaceutical companies consumed organic and inorganic iodine to manufacture various iodide-containing compounds. Iodine was also used as catalysts, food supplements, stabilizers, in inks and colorants, pharmaceuticals, and for sanitary uses. Leading producers were J.T. Baker Chemical Co., Warren County; Cooper Chemical Co., Morris County; Merck & Co., Inc., Union County; and S.B. Penick & Co., Hudson County.

Lime.—Limestone Products Corp., Sussex County, was the only producer of lime in the State. Lime was used mainly in chemicals, refractories, construction products, and for agricultural purposes.

Magnesium Compounds.—New Jersey ranked third, behind Michigan and California, in production of magnesium compounds, but ranked fifth in value. Harbison-Walker Refractories extracted magnesium compounds from seawater in Cape May County. Production in 1979 exceeded that of 1978 by 20%; value increased more than 77%. Uses were in refractories, fertilizers, pharmaceuticals, and other chemical processing and manufacturing applications.

Peat.—New Jersey ranked eighth nationally in 1979, producing 23,000 short tons of peat valued at $549,000, a slight decrease in production and value compared with that of 1978. Six plants operated in 1979, producing reed sedge and humus. Sussex County producers were Hygrade Humus Co., Hyper-Humus Co., Mt. Bethel Humus Co., Inc., Netcong Natural Products, and Stan's Soils. Kelsey Humus & Partac Co. operated the only plant in Warren County. The average prices per short ton for reed sedge and humus were $22.00 and $24.62, respectively. Uses included soil improvement, packing of flowers, and as an ingredient for potting soil.

Perlite (Expanded).—Crude perlite, mined in other States, was shipped into New Jersey and expanded by Grefco, Inc., Jamesburg, and The Schundler Co., Edison, both in Middlesex County. In 1979, production of expanded perlite remained unchanged compared with that of 1978, but value increased nearly 8%. The product was used in roof insulation, plaster, masonry products, and as a soil conditioner.

Table 4.—New Jersey: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	2,814	$6,061	$2.15	3,540	$9,703	$2.74	2,922	$8,544	$2.92
Plaster and gunite sands	NA	NA	NA	139	469	3.38	232	702	3.02
Concrete products	747	162	2.16	320	887	2.77	293	805	2.75
Asphaltic concrete	556	1,319	2.37	1,001	2,530	2.53	1,155	3,030	2.62
Roadbase and coverings	789	1,720	2.18	1,083	2,497	2.31	1,265	2,998	2.37
Fill	2,265	3,179	1.40	1,782	3,144	1.76	1,958	3,364	1.72
Snow and ice control	NA	NA	NA	67	206	3.05	284	1,301	4.58
Railroad ballast	W	W	W	--	--	--	--	--	--
Other uses	500	1,660	3.39	9	49	5.20	168	845	5.04
Total[1] or average	7,671	15,551	2.03	7,941	19,480	2.45	8,277	21,590	2.61

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Data may not add to totals shown because of independent rounding.

Table 5.—New Jersey: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	5,270	$9,961	$1.89	5,490	$12,637	$2.30	5,249	$12,555	$2.39
Gravel	2,401	5,590	2.33	2,451	6,848	2.79	3,027	9,036	2.98
Total[1] or average	7,671	15,551	2.03	7,941	19,480	2.45	8,277	21,590	2.61
Industrial sand	2,026	13,775	6.80	2,485	21,354	8.59	2,504	23,092	9.22
Grand total[1] or average	9,697	29,327	3.02	10,430	40,840	3.92	10,781	44,682	4.14

[1] Data may not add to totals shown because of independent rounding.

Table 6.—New Jersey: Sand and gravel sold or used, by county

(Thousand short tons and thousand dollars)

County	1977			1978			1979		
	Quantity	Value	Number of companies	Quantity	Value	Number of companies	Quantity	Value	Number of companies
Atlantic	W	W	2	197	594	4	178	714	4
Bergen	W	W	1	W	W	1	W	W	1
Burlington	W	W	2	508	757	3	341	706	1
Camden	1,032	1,983	4	1,255	2,841	4	954	2,381	4
Cape May	593	1,090	4	626	1,303	5	587	1,402	6
Cumberland	2,460	14,296	6	2,470	20,587	5	3,580	24,999	6
Gloucester	132	197	5	121	188	5	70	134	3
Middlesex	452	684	4	379	926	3	W	W	2
Monmouth	242	464	3	241	472	3	271	590	3
Morris	1,191	2,983	4	1,243	3,877	4	1,230	3,955	4
Ocean	1,182	3,283	7	1,280	2,643	7	1,161	2,396	7
Passaic	534	1,454	5	627	2,037	6	515	1,778	6
Sussex	237	463	7	737	1,641	7	526	1,282	7
Warren	W	W	2	W	W	2	585	2,354	2
Total[1]	9,697	29,327	56	10,430	40,840	59	10,781	44,682	56

W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Sand and Gravel.—Construction and industrial sand and gravel increased nearly 4% in quantity and 10% in value, from 1978 to 1979. In 1979, construction sand and gravel accounted for nearly 78% of the total output, but only 48% of the value; industrial sand accounted for the remainder. Higher unit values for industrial sand was the main reason for the difference in value.

Annual production of construction sand and gravel was approximately 8 million short tons. Cumberland County, with nine mines, led in production, followed by Morris, Ocean, Camden, and Warren Counties. Leading producers were New Jersey Silica Sand Co., Saxon Falls Sand & Gravel Co., Inc., and New Jersey Pulverizing Co. Construction sand and gravel was used mainly for concrete aggregate; other uses included plaster and gunite sands, concrete products, and fill.

Industrial sand was produced by five companies with eight operations in three of the State's southern counties. Cumberland County continued as the leading county, producing 84% of the State's total, followed by Camden and Gloucester Counties. Principal producers were Pennsylvania Glass Sand Corp., J. S. Morie & Son, Inc., and Whitehead Bros. Co. Principal uses for industrial sand were in the manufacture of glass products, molds and cores, refractories, and in sandblasting and filtration.

Stone.—New Jersey ranked 24th nationally in crushed stone production in 1978-79. Crushed stone was produced in 9 of the State's 21 counties, all in the northern part of the State. The leading counties were Somerset, Passaic, Sussex, and Hunterdon; they had 22 of the State's 27 crushed stone quarries, accounting for 84% of the production in 1979. Only three quarries produced over 900,000 short tons each, accounting for about 37% of the State total. The majority of the remaining quarries were in the 100,000- to 900,000-ton-per-year category.

Sixteen quarries produced traprock, eight granite, two limestone, and one dimension sandstone. Crushed traprock accounted for nearly 75% of all crushed stone, used mainly for aggregate and roadbase, with an average unit value of $4.05. Crushed granite was also used for aggregate and roadbase, with a unit value of $4.46. Nearly 95% of the crushed stone was transported by truck; the remainder was transported by rail.

Leading producers of traprock were Stavola Construction Materials, Trap Rock Industries, Inc., and Union Building & Construction Corp. Crushed granite was produced by Tri-County Asphalt Corp., Anthony Ferrante & Sons, Inc., and Lentine Aggregates. Crushed limestone was produced by Penn-Virginia Corp. Limestone Products.

Table 7.—New Jersey: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Poultry grit and mineral food	W	W	W	W	25	413
Concrete aggregate	[r]649	[r]1,790	1,028	3,297	1,168	4,568
Bituminous aggregate	2,094	6,775	2,593	9,566	2,228	9,770
Macadam aggregate	393	1,260	530	1,660	591	2,328
Dense-graded roadbase stone	3,057	9,434	3,280	11,028	3,758	15,756
Surface treatment aggregate	167	521	228	697	296	1,096
Other construction aggregate and roadstone	5,062	[r]18,348	4,076	15,436	4,673	21,162
Riprap and jetty stone	150	535	280	1,031	284	1,310
Railroad ballast	135	387	21	64	59	173
Filter stone	28	138	46	162	W	W
Manufactured fine aggregate (stone sand)	123	377	72	359	98	535
Terrazzo and exposed aggregate	--	--	105	1,734	37	679
Lime manufacture	W	W	18	56	--	--
Fill	11	10	11	10	--	--
Other uses[2]	1,125	7,047	903	5,082	733	5,386
Total[3]	12,993	46,621	13,192	50,181	13,950	63,174

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, and traprock.

[2] Includes stone used for agricultural limestone, flux stone, asphalt filler, other filler, acid neutralization (1977-78), roofing granules, sulfur removal from stack gases (1977), unspecified uses, and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Dimension sandstone was produced by Delaware Quarries, Hunterdon County, in the western part of the State. Output was sold for stone and house veneer, with unit value at $40 per short ton.

Sulfur.—Sulfur was recovered as a byproduct of petroleum refining in Gloucester, Middlesex, and Union Counties. Sulfur was used in the manufacture of sulfuric acid, fertilizers, plastics, paper products, explosives, and other products.

Vermiculite.—Vermiculite was shipped into the State and exfoliated by W. R. Grace & Co., Trenton, Mercer County; and The Schundler Co., Metuchen, Middlesex County. Exfoliated vermiculite was used for agricultural purposes, loose-fill insulation, fireproofing, and lightweight aggregate.

METALS

Ferroalloys.—New Jersey ranked 13th nationally in the production of ferroalloys. Twenty-two companies produced ferroalloys of vanadium, titanium, boron, columbium, and aluminum, including silicon and zirconium alloys. These ferroalloys were used in the manufacture of cast iron products, bolts, metal brake shoes, automobile mufflers, tool steel, and miscellaneous products.

Iron Ore.—Mt. Hope Mining Co. opened the previously abandoned underground iron ore mine located north of Dover, Morris County, in late 1977, and terminated operations in early 1978 because of economic conditions. A small amount of ore was shipped in 1977-78.

Iron Oxide Pigments.—Iron oxide pigments, used mainly in the manufacture of paints, were produced by three companies in four counties. Production in 1979 totaled 11,225 short tons valued at $9.97 million, an increase of nearly 5% in quantity and nearly 8% in value, compared with 1978 levels. Iron oxide pigments were produced by Combustion Engineering Corp., Camden County; E. I. du Pont de Nemours & Co., Inc., Essex County; and Cities Service Co., Mercer and Middlesex Counties.

Selenium.—New Jersey ranked second nationally in the production of selenium. AMAX, Inc., at Carteret, near Newark, produced selenium as a byproduct of the electrolytic copper-refining process. Selenium was used in glass manufacturing, pigments, specialty steels, and electronic components.

Tellurium.—In 1979, AMAX, Inc., Carteret, produced nearly 17% less tellurium than in 1978. Tellurium was recovered from the metal anode slimes obtained from the electrolytic refining of copper. Major uses of tellurium were for mold dressing and cast iron products, for improvement of steel machinability, and in various chemicals.

Titanium.—Ilmenite was produced by Glidden-Durkee Div. of SCM Corp. and ASARCO Inc., Lakehurst, Ocean County. Production and value in 1979 decreased compared with that of 1978. The chief source of titanium is ilmenite, found in sand deposits near the seashore. The sand deposits are dredged and the product processed, yielding concentrate of approximately 63% titanium dioxide. The product was used in the manufacture of paints, paper, rubber, and leather products.

Zinc.—New Jersey ranked fourth nationally in 1979, producing 31,118 metric tons of zinc valued at $25.6 million. Output and value increased 8% and 29% respectively from 1978 to 1979. Zinc was produced only in Sussex County, and the crushed ore was shipped to a company-owned smelter located in Pennsylvania. Zinc was used mainly for galvanizing, brass products, and zinc-base alloys.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
J. S. Morie & Son, Inc.[1]	Box 35 Mauricetown, NJ 08329	Pit	Cumberland.
New Jersey Shale Brick & Tile Corp	Box 490 Somerville, NJ 08876	Plant	Somerset.
Greensand marl: Inversand Co	226 Atlantic Ave. Clayton, NJ 08312	Pit	Gloucester.
Gypsum, calcined:			
Flintkote Co	480 Central Ave. East Rutherford, NJ 07073	Plant	Camden.
National Gypsum Co	4100 First Intl. Bldg. Dallas, TX 75270	do	Burlington.
Ilmenite:			
ASARCO, Inc	Route 70, Mile 41 Lakehurst, NJ 08733	do	Ocean.
Glidden-Durkee Div. of SCM Corp	Box 5 Lakehurst, NJ 08733	do	Do.
Iron oxide pigments (manufactured):			
Cities Service Co	380 Madison Ave. New York, NY 10017	do	Mercer and Middlesex.
Combustion Engineering, C. E. Minerals Div	901 East 8th Ave. King of Prussia, PA 19406	do	Camden.
E. I. du Pont de Nemours & Co., Inc	Du Pont Bldg. D 10034 Wilmington, DE 19898	do	Essex.
Magnesium compounds:			
Harbison-Walker Refractories, a Division of Dresser Industries, Inc.	2 Gateway Center Pittsburgh, PA 15222	do	Cape May.
Peat:			
Hyper-Humus Co	Lafayette Rd., Box 267 Newton, NJ 07860	Bog	Sussex.
Kelsey Humus & Partac Co	Kelsey Park Great Meadows, NJ 07838	Bog	Warren.
Mt. Bethel Humus Co., Inc	315 West 57th St. New York, NY 10019	Bog	Sussex.
Netcong Natural Products	738 Route 10 Randolph, NJ 07801	Bog	Do.
Perlite (expanded):			
Grefco, Inc	3450 Wilshire Blvd. Los Angeles, CA 90010	Plant	Middlesex.
The Schundler Co.[2]	Box 251 Metuchen, NJ 08840	do	Do.
Sand and gravel:			
New Jersey Pulverizing Co	115 Hickory Ln. Bayville, NJ 08721	Pit	Ocean.
New Jersey Silica Sand Co	Millville, NJ 08332	Dredge	Cumberland.
Pennsylvania Glass Sand Corp	Berkeley Springs, WV 25411	Pit	Do.
Saxon Falls Sand & Gravel Co., Inc	R.D. 3 Stanhope, NJ 07874	Pit	Morris.
Whitehead Brothers Co	60 Hanover Rd. Florham Park, NJ 07932	Pit and dredge.	Cumberland.
Stone:			
Granite, crushed and broken:			
Anthony Ferrante & Sons, Inc	Route 202, Mine Brook Rd. Bernardsville NJ 07924	Quarry	Hunterdon and Somerset.
Tri-County Asphalt Corp	Route 15 Hopatcong, NJ 07843	do	Sussex.
Traprock (basalt), crushed and broken:			
Stavola Construction Materials	Hamilton Rd. Red Bank, NJ 07701	do	Somerset.
Trap Rock Industries, Inc	Laurel Ave. Kingston, NJ 08528	do	Hunterdon, Mercer, Somerset.
Union Building & Construction Corp	1111 Clifton Ave. Clifton, NJ 07013	do	Passaic.
Sulfur (recovered):			
Chevron Oil Co	1200 State St. Perth Amboy, NJ 08861	Plant	Middlesex.
Exxon Co., U.S.A.	Box 23 Linden, NJ 07036	do	Union.
Mobil Oil Corp	Paulsboro, NJ 08066	do	Gloucester.
Texaco, Inc	Eagle Point, Box 52332 Houston, TX 77052	do	Do.
Vermiculite (exfoliated):			
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	do	Mercer.

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[1] Also sand and gravel.
[2] Also exfoliated vermiculite.

The Mineral Industry of New Mexico

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the New Mexico Department of Energy and Minerals for collecting information on all nonfuel minerals.

By Robert H. Arndt[1] and Robert W. Eveleth[2]

The value of nonfuel minerals produced in New Mexico rose abruptly during the second year of the 1978-79 biennium to a record of $695 million. The record was achieved after 4 years of fluctuating annual values characterized by lows in 1975 and 1978 and an intervening high in 1976. A strong surge in the value of produced copper, gold, potash, and silver supported the increase in 1979 to about 46% above the value in 1978

Table 1.—Nonfuel mineral production in New Mexico[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2] thousand short tons	69	$113	65	$108	74	$124
Copper (recoverable content of ores, etc.) metric tons	149,412	220,037	127,828	187,405	164,281	336,934
Gem stones	NA	170	NA	180	NA	180
Gold (recoverable content of ores, etc.) troy ounces	13,560	2,011	9,879	1,912	22,976	7,065
Gypsum thousand short tons	182	1,227	263	2,649	251	3,244
Lead (recoverable content of ores, etc.) metric tons	W	W	W	W	43	49
Manganiferous ore (5% to 35% Mn) short tons	29,120	W	36,443	W	33,152	W
Mica, scrap thousand short tons	14	W	16	W	17	W
Peat do	2	55	2	60	2	40
Perlite do	521	9,543	576	12,510	588	14,874
Potassium salts thousand metric tons	1,891	169,616	1,943	183,554	2,005	228,776
Pumice thousand short tons	457	1,835	631	2,706	604	3,550
Salt do	W	W	180	1,617	W	W
Sand and gravel do	8,604	17,685	8,239	17,850	7,141	18,245
Silver (recoverable content of ores, etc.) thousand troy ounces	918	4,242	W	W	W	W
Stone:						
Crushed thousand short tons	1,950	4,786	2,438	6,157	2,589	6,743
Dimension do	17	106	18	115	20	117
Tin metric tons	--	--	W	W	--	--
Combined value of barite (1979), carbon dioxide, cement, clays, (fire clay), helium (high-purity 1977-78), lead, lime, molybdenum, vanadium, zinc, and values indicated by symbol W	XX	65,617	XX	60,736	XX	74,507
Total	XX	497,043	XX	477,559	XX	694,448

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fire clay; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in New Mexico, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Bernalillo	$28,506	$29,744	Cement, sand and gravel, stone, clays.
Catron	W	W	Silver, tin, gold, salt, stone, copper, lead.
Chaves	561	712	Sand and gravel.
Colfax	W	W	Do.
Curry	W	W	Sand and gravel, stone.
De Baca	175	175	Sand and gravel.
Dona Ana	1,855	W	Sand and gravel, pumice, stone, clays.
Eddy	160,688	W	Potassium salts, salt, sand and gravel.
Grant	241,916	202,682	Copper, silver, zinc, lime, gold, molybdenum, lead, stone, manganiferous ore, sand and gravel.
Guadalupe	W	W	Stone, sand and gravel.
Harding	W	W	Natural carbon dioxide.
Hidalgo	399	W	Stone, clays, silver, gold, lead, zinc.
Lea	W	W	Potassium salts, sand and gravel, stone, salt.
Lincoln	W	68	Sand and gravel.
Luna	W	W	Sand and gravel, clays, stone.
McKinley	1,006	W	Stone, vanadium, molybdenum.
Mora	3	3	Sand and gravel.
Otero	504	412	Do.
Quay	W	W	Do.
Rio Arriba	W	W	Stone, pumice, sand and gravel.
Roosevelt	W	W	Stone.
Sandoval	1,190	W	Gypsum, sand and gravel, peat, pumice.
San Juan	W	W	Sand and gravel, helium, pumice, clays.
San Miguel	396	201	Sand and gravel.
Santa Fe	W	W	Sand and gravel, pumice, gypsum.
Sierra	W	W	Sand and gravel, silver, copper.
Socorro	1,350	W	Perlite, stone, sand and gravel, pumice.
Taos	37,486	36,442	Molybdenum, perlite, mica, stone, sand and gravel.
Torrance	163	124	Sand and gravel.
Union	W	W	Pumice, sand and gravel.
Valencia	W	715	Sand and gravel, perlite, stone.
Undistributed[2]	20,840	206,278	
Total[3]	497,043	477,559	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Los Alamos county is not listed because no nonfuel mineral production was reported.

[2] Includes some sand and gravel that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

and almost 53% above the value in 1975. The general pattern of fluctuation of total value of mineral output, however, corresponded over the 5-year interval essentially to that of produced copper, the State's leading nonfuel mineral.

Twenty-five nonfuel mineral commodities were produced in 1978 and 23 in 1979. In both years, values of copper and potash each exceeded $180 million. Produced cement, molybdenite, perlite, and sand and gravel were individually valued at more than $10 million. The values of carbon dioxide, gold, gypsum, lime, pumice, salt, and stone each surpassed $1 million. The value of zinc output exceeded $3 million in 1978, and that of silver exceeded $10 million in 1979. Metals and ores of metals mined in 1979 had a total value of about $395 million, and nonmetals were valued at about $299 million.

Almost 8,000 workers were employed in the mining, treatment, and smelting of nonfuel minerals in 1978. The distribution of employment by type of material mined and the character of the mining activity was based on the 66th Annual Report of the New Mexico Bureau of Mine Inspection. Average monthly employment in mining nonfuel minerals during the first three quarters of 1979, estimated from data in the New Mexico Employment Security Department's quarterly report, "Covered Employment and Wages," was metals, 3,329; nonmetals, 3,218.

	Metals	Nonmetals	Sand and gravel	Smelters	Total
Surface	1,459	636	476	--	2,571
Underground	383	1,525	--	--	1,908
Mill or plant	875	545	369	739	2,528
Other	450	186	91	--	727
Total	3,167	2,892	939	739	7,734

Table 3.—Indicators of New Mexico business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	505.0	526.0	538.0	+2.3
Unemployment do	39.0	30.0	35.0	+16.7
Employment (nonagricultural):				
Mining[1] do	23.4	24.4	26.8	+9.8
Manufacturing do	32.2	33.4	34.7	+3.9
Contract construction do	30.7	35.0	36.4	+4.0
Transportation and public utilities do	24.6	26.6	28.1	+5.6
Wholesale and retail trade do	95.5	101.2	104.6	+3.4
Finance, insurance, real estate do	18.3	19.8	21.2	+7.1
Services do	79.7	87.3	88.7	+1.6
Government do	111.0	116.6	121.0	+3.8
Total nonagricultural employment do	415.4	444.3	461.5	+3.9
Personal income:				
Total millions	$7,008	$7,999	$9,052	+13.2
Per capita	$5,859	$6,599	$7,294	+10.5
Construction activity:				
Number of private and public residential units authorized	13,667	[2]15,353	13,383	-12.8
Value of nonresidential construction millions	$110.1	$170.7	$174.4	+2.2
Value of State road contract awards do	$65.0	$104.0	$89.3	-14.1
Shipments of portland and masonry cement to and within the State thousand short tons	636	648	593	-8.5
Nonfuel mineral production value:				
Total crude mineral value millions	$497.0	$477.6	$694.4	+45.4
Value per capita, resident population	$410	$399	$560	+40.4
Value per square mile	$4,085	$3,925	$5,708	+45.4

[p] Preliminary.

[1] Includes bituminous coal and oil and gas extraction.

[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

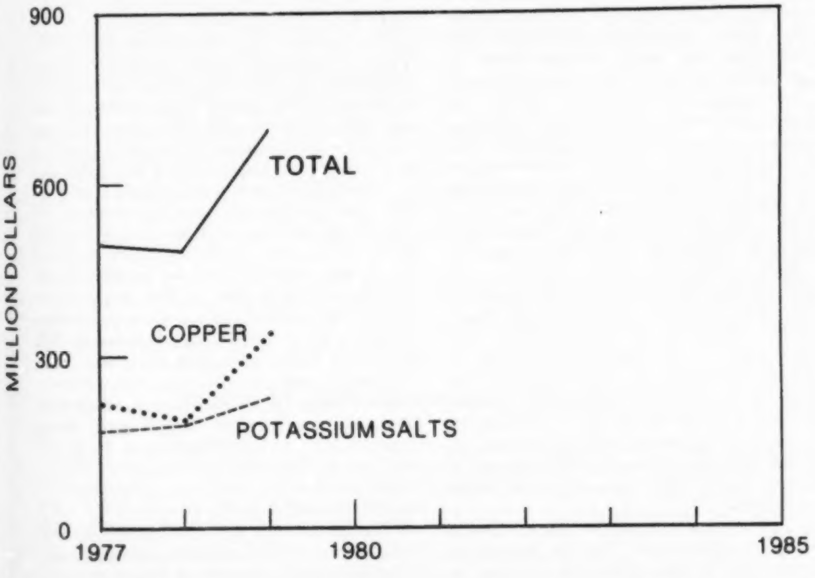

Figure 1.—Value of potassium salts, copper, and total value of nonfuel mineral production in New Mexico.

Legislation and Government Programs.—State reorganization concerned with mineral matters became effective on April 1, 1978, as a consequence of passage of Law 1977, Chapter 355, by the 1977 New Mexico Legislature. The law established the Energy and Minerals Department with three bureaus—the Bureau of Geology, the Bureau of Surface Mining, and the Bureau of Mine Inspection. By mutual agreement, the regulatory functions of the Department's Bureau of Geology and Bureau of Surface Mining were related essentially to energy materials and resources, leaving the problems of nonfuel minerals largely with the long-established New Mexico Bureau of Mines and Mineral Resources.

The 1979 State Legislature passed several bills that would indirectly affect mining. Senate Bill 200 amended the Natural Gas Pricing Act to establish natural gas prices for State consumers at a level low enough to be comparable with those in out-of-State markets without jeopardizing incentive prices to producers. Such prices would affect commercial and industrial consumers of large quantities of natural gas such as cement manufacturers and other mineral processors. Appropriations of $200,000 to the Department of Educational Finance and Cultural Affairs, or its successor agency, by Senate Bill 224, authorized a study to evaluate scientific and cultural values of fossils in New Mexico. An objective of the bill was to determine whether it would be desirable to make evaluation of fossil materials a part of the environmental impact studies for massive construction and mining projects.

Among other activities, Senate Bill 377 provided for active cooperation between the Mining and Minerals Division of the Energy and Minerals Department and the New Mexico Bureau of Mines and Mineral Resources in the preparation and publication of maps, brochures, and pamphlets, and made the State Mine Inspector an Assistant to the Director of the Mining and Minerals Division. The State Senate recognized that mine dewatering involves use or disposal of the pumped water and directed by Senate Memorial 52 that the Legislative Council arrange for proper study of the problem by an interim committee with a report on findings and suggestions to be completed for delivery to the 1979 session of the State Legislature.

A prime function of the New Mexico Bureau of Mines and Mineral Resources during 1978-79 was providing service in response to public requests, on behalf of academic, economic, and technologic research related to mineral resources and the environment, and to disseminate acquired knowledge. Many samples of water, ores, concentrates, geological samples, and leach liquids submitted by the public were analyzed by quantitative and qualitative wet chemical, optical-spectrographic, atomic absorption, x-ray, and electron-microprobe spectrometry techniques. Metallurgical staff members provided routine tests of materials, and technical assistance in metallurgical problems and investigations, and in biological applications in mining. The State Bureau also disseminated general and special mineral and geological information through displays in the Mineral Museum and sponsorship of symposia to review regional geology, special aspects of mining, mineral occurrences, and mineral resources and reserves. Staff members were actively involved in projects investigating resources and economic potential of nonfuels industrial minerals including clay, shale, perlite, scoria, limestone, and zeolites. An evaluation of the U.S. Department of Energy's proposed Waste Isolation Pilot Plant Site (WIPP) in Eddy County considered the project's impact on mineral resources and mineral environment. Metallurgists were engaged in research in column leaching of low-grade chalcopyrite ores using thermophilic bacteria (in cooperation with the Federal Bureau of Mines), and other studies of biological processes potentially applicable to mining. Field mapping of geology and associated mineral resources was in progress on a broad scale in Socorro County, specifically for barite-fluorite-lead deposits in Socorro's Hansonburg mining district. Other similar mapping was underway in Lincoln County (manganese and gold), in the Cooke's Peak stock in Luna County (trace base metals), and in north-central New Mexico (with the U.S. Geological Survey) for evaluation of minerals in the Pecos Wilderness. In addition, other areas of the State were under geological study and field mapping. These included the Doctor Creek area of Sante Fe County, the Rociada-Elk Mountain area in San Miguel and Mora Counties, the Organ Mountains of Dona Ana County, the Chise quadrangle of Sierra County, and the Pecos mining district of San Miguel and Sante Fe Counties.

Data about locations of all known mining installations in the State were being compiled for the Federal Bureau of Mines Mineral

Industry Location System (MILS). Similar data covering all active mines, mineral processing plants, and powerplants were compiled for a map and index of the State's mineral industries. Supplementary data were compiled for the Bibliography of New Mexico Geology and Mineral Technology through 1975. Separate data were compiled for the interval 1976-1980.

The introduction of "New Mexico Geology", a quarterly journal of science and service, in 1979 was a highlight of the State Bureau's publications. Individual publications having noteworthy impact on nonfuel minerals were Resource Map 9, "Mines, Processing Plants, and Power Plants in New Mexico," 1979; a reissue of Bulletin 67, "Mineral Deposits of Lincoln County, New Mexico," 1959; and Open-File report OF 87, "Evaluation of the Mineral Potential (Excluding Hydrocarbons, Potash, and Water) of the Waste Isolation Pilot Plant Site, Eddy County, New Mexico", 1978. Free pricelist 13, "Publications Available from New Mexico Bureau of Mines and Mineral Resources"[3] was issued in 1979.

During the biennium, the New Mexico Institute of Mining and Technology was designated by the Secretary of the Interior as a State Mining and Minerals Resources and Research Institute pursuant to Title III of Public Law 95-87, "The Surface Mining Control and Reclamation Act of 1979." The Institute program has for its purposes "Specific mineral research and demonstration projects of industrywide application, which could not otherwise be undertaken.... (and) research into any aspects of mining and mineral resources problems related to the mission of the Department of the Interior, which may be deemed desirable and are not otherwise being studied." The Institute was designed to provide for the training of mineral engineers and scientists through its research program.

The Federal Bureau of Mines conducted and sponsored research by commercial, governmental, and academic institutions in New Mexico in the fields of mining health and safety, environmental engineering, metallurgy, and field data collection through contracts and grants. A.R.F. Products, Inc., was developing hardware for wireless mine communication systems. The microbiological flocculation of phosphate slimes and column leaching of low-grade chalcopyrite ores using thermophilic bacteria were studied at the New Mexico Institute of Mining and Technology. Kaiser Steel Co. at Raton provided exploratory drilling and well logging services. The New Mexico Bureau of Mines collected and compiled mine location data for the Federal Bureau of Mines Mineral Industry Location System. The Federal Bureau of Mines evaluated mining properties, methods, and costs of mining in New Mexico mines for its Minerals Availability System. Two grants were made to the Technology Application Center, University of New Mexico, for projects in satellite remote sensing of surface mining phenomena.

Mineral assessments on wilderness, natural, and primitive areas, on Indian lands, and Forest Service roadless areas (RARE II) were made by the Bureau of Mines and in cooperation with the U.S. Geological Survey and in coordination with the Bureau of Indian Affairs, Bureau of Land Management, and U.S. Forest Service. Wilderness and natural areas that were investigated in some manner during the biennium were: White Mountain Wilderness Area (U.S. Geological Survey published report), El Malpais Natural Area, and Pecos Wilderness. RARE II areas investigated for the U.S. Forest Service were Hell Hole (Arizona-New Mexico), Pecos, and Columbine-Hondo. Negotiations for field investigations, or active investigations and drilling of mineral resources on Indian land involved the Acoma Reservation, Alamo Reservation, Cochiti Pueblo, Jemez and Zia Pueblos, Laguna Reservation, Sandia Pueblo Reservation, San Felipe Pueblo Reservation, Santa Ana Pueblo, and Santo Domingo Pueblo.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Copper.—Output and value of copper produced in the State of New Mexico rose to a 5-year high in 1979 after 4 years in which they fluctuated widely. Fluctuations in the previous years were associated with modest changes in the relatively low price of copper, except in 1978 when copper production was strongly curtailed by a 9-month strike at UV Industries' Continental mine. Except for very small quantities of copper obtained from ores mined in Socorro, Sierra, Catron, and Hidalgo Counties, the majority of ore was mined in Grant County at nine mines in 1978 and six mines in 1979. Copper was also obtained from three mines outside of Grant County in each year. The Tyrone mine of Phelps Dodge Corp., Kennecott's Santa Rita pit, and UV Industries' Continental mine at Fierro were the sources of more than 99% of the copper produced in New Mexico. At least five other operations individually produced at least 10,000 pounds per year or more of recoverable metal. Much of this was a byproduct of mining for other metals such as zinc, lead, gold, and silver.

Phelps Dodge Corp. led all other companies in the production of copper during the biennium, mining and concentrating ore at its open pit and concentrator facility at Tyrone. At full capacity, about 250,000 tons of ore and waste are removed from the open pit daily, and about 50,000 tons per day of ore are treated in the concentrator. Concentrates were shipped from the mine to the firm's smelter in Hidalgo County, where copper and byproduct gold and silver were recovered. Smelter needs supported ancillary mining of silica rock and fire clay in Hidalgo County. Kennecott Corp. was second in production of copper both years. Ore was mined by the Chino Mines Division in the pit at Santa Rita and carried by rail to the concentrator and smelter at Hurley, where gold, silver, and molybdenum were recovered along with the copper. UV Industries mined complex ores at the Continental mine. Copper, iron, zinc, lead, gold, and silver were recovered from Continental ores.

Labor problems, environmental issues, and exploration and development of mining properties were events of importance to the copper industry. Phelps Dodge, seeking water for a leaching operation on 640 acres of land, filed notice of intent to drill six wells in the Mimbres Basin south of Silver City to recover 6,000-acre-feet per year of water. Chino Mines and the Luna County Farm Bureau filed objections to the action. In October 1979, Phelps Dodge employed an engineer to make daily safety inspections of the tailings ponds and retaining dams in compliance with a new State program for dam safety.

To combat low copper prices, Kennecott Copper Corp. reduced its mining rate by laying off more than 100 employees in February 1978, and reduced mine and concentrator work schedules from 21 shifts to 15 shifts per week. The smelter continued operating on a normal schedule, drawing from large stocks of concentrates. The firm also announced on May 26th that the company's daily copper price would be 2.5 cents higher than the New York Commodity Exchange (COMEX) closing price of the previous day. Kennecott continued its opposition to State and Federal environmental controls directed at smelter operations, particularly the State Environmental Improvement Board's 1978 revised standards for sulfur emission at the Hurley smelter. Kennecott indicated that the cost of reconstructing the smelter to achieve the equivalent of 87% control of emissions demanded by the State would be $100 million. Late in 1979, the dispute was referred to the Court of Appeals.

In response to EPA pressure concerning smelter and mine discharge of liquids into Santa Rita and White Water Creeks, the firm demonstrated that neither creek was navigable, that Kennecott was the only user, that the streams dissipated voluntarily, and that EPA thus had no jurisdiction over the situation. A record for safety was established within Kennecott in 1979, when the limestone quarry and lime plant that serve the smelter celebrated 25 years of operation without a lost-time accident. Management's plans for restructuring the company involved a change of name of the metal-mining division to Kennecott Minerals Co., which acknowledged the broader activities of the firm. Management also announced that plans were being made to update the concentrator and other facilities of the Chino Mining Division and the Hurley smelter at a cost of about $300 million. A vital objective was a 20-30 cents per pound reduction of the cost of producing copper.

A strike of United Steel Workers of America and operating engineers' union members at the Continental mine of UV Industries, Inc., lasted from April 1, 1978, to January 10, 1979. Consequently, annual copper output at the Continental mine in 1978 was approximately one quarter of what it was in 1979 after settlement of the strike. Early in 1979, UV's board of directors approved a plan to liquidate the company holdings and distribute the proceeds to share holders. Sharon Steel Corp. acquired UV's mining interests on November 26, 1979. In 1978, before the move for liquidation, UV Industries had announced the discovery at its Fierro prospect of 10.5 million tons of ore that had a copper content of more than 0.6%.

Exploratory drilling over a period of several years in the Pinos Altos area northeast of Silver City enabled Exxon Minerals Co. to outline deposits estimated to contain 7 million tons of ore at a grade of about 2% copper and 3% zinc, plus recoverable silver and gold. Ore bodies consist of fissure veins and replacements in sedimentary rock adjacent to igneous intrusives. Deposits lie at depths from 400 feet to more than 1,500 feet below a surface area that is about 2,500 feet long and 1,000 feet wide. Exxon planned underground exploration and development for an engineering analysis of the property. The firm requested, and was awarded by a Special Master appointed by the State District Court, rights to 2,820 acre-feet of water annually from the Gabby Hayes well near the Tyrone townsite. Exxon also arranged with the City Council of Silver City for the delivery of as much as 700-acre-feet per year of sewer plant effluent at a price of 28 cents per thousand gallons or an exchange for fresh water. The new water supplies would supplement 2,500 acre-feet of water rights that are held in the Mimbres Basin south of Silver City. In December 1979, Community Public Service Co. and Exxon were discussing the potentialities for building electric power lines to the Pinos Altos area for operating the planned mine.

Quintana Minerals Corp. of Tucson, Ariz., resumed preparations for mining copper by open pit methods at Copper Flats northeast of Hillsboro in Sierra County. The firm was in the process of completing legal and operational agreements including arrangements with Sierra Electric and Plains Electric Co.'s for construction of power lines from Truth or Consequences to the mine site. Quintana planned to commence mining in 1980.

Between 1974 and 1979, Gulf Mineral Resources Co. acquired more than 525 min-

Table 4.—New Mexico: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Mines producing[1]		Material sold or treated (metric tons)	Gold		Silver	
	Lode	Placer		Troy ounces	Value	Troy ounces	Value
1977, total	10	1	22,171,328	13,560	$2,011,083	918,155	$4,241,874
1978:							
Catron	1	--	392	99	19,161	5,448	29,419
Grant	8	--	19,885,233	9,777	1,892,340	W	W
Hidalgo	1	--	11	3	581	251	1,355
Sierra	1	--	53	--	--	266	1,436
Total	11	--	19,885,689	9,879	1,912,082	W	W
1979:							
Grant	6	--	24,639,527	22,962	7,060,816	W	W
Undistributed[2]	3	1	633	14	4,306	W	W
Total	9	1	24,640,160	22,976	7,065,122	W	W

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1977, total	149,412	$220,036,796	W	W	W	W	$238,093,453
1978:							
Catron	(3)	275	(3)	98	--	--	48,953
Grant	127,827	187,404,241	W	W	W	W	198,118,258
Hidalgo	--	--	(3)	190	(3)	94	2,220
Sierra	(3)	434	--	--	--	--	1,870
Total[4]	127,828	187,404,950	W	W	W	W	198,171,301
1979:							
Grant	164,274	336,920,229	39	44,980	W	W	359,170,905
Undistributed[2]	7	13,845	3	4,018	W	W	39,356
Total	164,281	336,934,074	43	48,998	W	W	359,210,261

W Withheld to avoid disclosing company proprietary data.

[1] Operations at plants leaching runoff water not counted as mines.

[2] Includes Hidalgo, Sierra, and Socorro Counties, combined to avoid disclosing company proprietary data.

[3] Less than 1/2 unit.

[4] Data may not add to totals shown because of independent rounding.

Table 5.—New Mexico: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by class of ore or other source material

Source	Number of mines[1]	Material sold or treated (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
1978							
Lode ore:							
Gold, silver, gold-silver[2]	6	19,112	5,324	W	15	55	22
Copper and zinc	5	19,841,558	4,555	W	109,163	W	W
Total	11	19,860,670	9,879	W	109,178	W	W
Other lode material:							
Copper precipitates and copper cleanup	1	25,019	--	--	18,650	--	--
Total lode material	11	19,885,689	9,879	W	127,828	W	W
1979							
Lode ore:							
Gold	1	2,000	567	W	2	6	W
Gold-silver	1	12,000	3,112	W	9	28	W
Copper and lead[3]	7	24626,000	19,285	W	164,270	8	W
Total	9	24640,000	22,964	W	164,281	[4]43	W
Placer	1		12	--	--	--	--
Grand total	10	24640,000	22,976	W	164,281	43	W

W Withheld to avoid disclosing company proprietary data.

[1] Detail will not add to totals shown because some mines produce more than one class of material.

[2] Combined to avoid disclosing company proprietary data in 1978 but not in 1979.

[3] Includes copper leached from copper ore and copper precipitates.

[4] Data do not add to total shown because of independent rounding.

Table 6.—New Mexico: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
1978					
Lode:					
Smelting of concentrates	4,557	W	109,146	W	W
Direct smelting of:					
Ore	5,322	W	32	55	27
Precipitates and cleanup	--	--	18,650	--	--
Total lode material	9,879	W	127,828	W	W
1979					
Lode:					
Smelting of concentrates	19,284	W	148,801	8	W
Direct smelting of ore	3,680	W	15,480	34	W
Total	22,964	W	164,281	[2]43	W
Placer	12		-		--
Grand total	22,976	W	164,281	43	W

W Withheld to avoid disclosing company proprietary data.

[1] Combined to avoid disclosing company proprietary data.

[2] Data do not add to total shown because of independent rounding.

ing claims and 13,440 acres of Federal land in the Tres Hermanas and Victorio mining districts of Luna County. Mineral objectives of the acquisitions were not identified. It was reported by affidavit that the firm's drilling operations had encountered copper mineralization in the Tres Hermanas mining district.

Occidental Minerals Corp. announced in February of 1978 that depressed copper prices and the high cost of meeting environmental restrictions caused indefinite suspension of an in situ copper leaching facility near Cerrillos in Sante Fe County.

Gold.—Under stimulus of gold prices that soared to an average of $307.50 per troy ounce, gold production and value reached a 5-year high in 1979. By contrast, production in 1978 was the lowest in the period 1975 through 1979. Much of the increase in gold production was a byproduct derivative of expanding copper mining in Grant County. Gold-bearing ores were mined in Catron, Grant, Hidalgo, and Sierra Counties during the 1978-79 biennium. In all, 12 mines reported production during that time. Four mines in Grant County, one in Hidalgo County, and one in Sierra County reported gold recoveries in both years. The remaining six reported gold recovery in one of the two years. Although most of the gold was recovered in the smelting of copper ores from Grant County, a portion came from ores mined primarily for zinc and lead. One placer operation near Hillsboro in Sierra County reported gold recoveries in 1979. Several gold recovery operations were in the development stage. Gold Fields Mining Corp., a subsidiary of Consolidated Gold Fields, Ltd., was engaged in preparing an open pit mine near Cerrillos in Sante Fe County, about 35 miles south of Santa Fe. The firm planned to use heap leaching to recover the gold. In December 1979, the State Engineer approved water rights for Gold Fields amounting to 2,047 acre-feet, deliverable over a 30-year period. Challenge Mining Co. was applying heap leaching to gold- and silver-bearing ores from surface vein exposures and mine dump materials of the formerly abandoned Eberle mine in the Cooney district near Mogollon in southwest Catron County. New Cinch Uranium, Ltd., of Canada, was prospecting for gold, silver, and copper deposits northwest of Orogrande in Otero County. Drilling was reported to have found ore deposits grading 0.045 ounces of gold and appreciable silver per ton. Exploration continued at yearend 1979.

Lead.—The Central mining district of Grant County was the State's main source of lead. Until the middle of 1978, most of the lead from that area had come from the ASARCO, Inc., Ground Hog Unit at Vanadium. Low prices of lead, averaging about $0.31 per pound in 1977 and $0.34 per pound in 1978, and depressed prices of zinc in 1978, induced ASARCO to close its Ground Hog Unit in the middle of the year and to ship its last carload of ore to a concentrator at Deming on September 5. Thereafter, although eight mines remained in production in Catron, Grant, Hidalgo, and Sierra Counties in 1978 and five mines in 1979, New Mexico's output of lead in 1979 was only 2% of that in 1977. Loss in value of the product was comparable in the same period. Summit Minerals' Summit mine, UV Industries, Inc.'s Continental mine, and Dresser Industries, Inc.'s Center mine produced significant quantities of lead during the biennium. Output from other mines was 8 less than 10% of the State's total output.

Molybdenum.—New Mexico's output of molybdenum dropped drastically in 1978 to about one-half its normal quantity and recovered only slightly in 1979. Value of the output, however, rose to a 5-year high in 1979 as worldwide demand for molybdenum exceeded production capacity and forced the average unit value of molybdenum mined in the United States from about $3.60 per pound of contained molybdenum in 90% molybdenum disulfide concentrates in 1977 to $6.07 per pound in 1979. The decline in production resulted from a drop in production at Union Oil Co. of California's Molycorp Division. A strike of 96 days' duration that started in late 1977 was settled at the Questa, N. Mex., mine on March 16, 1978. Molycorp also had difficulty operating their open pit as ore reserves approached depletion. Nevertheless, Union Oil Co. reported that the rising prices of molybdenum had allowed a 43% increase in the value of molybdenum ore mined in 1979 over that mined in 1978. Spot prices were more than $30 per pound. Relatively small quantities of molybdenum were recovered as byproducts of concentration of copper ore by Kennecott Copper Corp. at its Hurley smelter and by Kerr-McGee Corp. in the process of concentrating uranium ores at its Ambrosia Lake mill.

After several years of exploratory drilling in the Goat Hill area near their open pit, Molycorp was able to define an ore body about 400 feet wide and 1 mile long at a depth of about 400 feet with reserves of 120 million tons of ore. When fully developed, the ore would yield about 18 million pounds per year of molybdenum for 20 years if mined at a rate of about 18,000 tons per day. Stearns-Roger of Denver designed and engineered underground mine facilities to develop and mine the new ore body. Molycorp planned to spend about $200 million in the installation of two vertical shafts 1,300 feet deep for service and ventilation and a 6,500-foot decline to accommodate an ore conveyor belt. Headframes for the two shafts were installed and shaft sinking began in 1979, with anticipated completion in January 1983. Mining by block caving would reach its anticipated capacity in 1984 with a work force of 1,000. The firm also expected to modify its concentrating mill. In 1979, the firm undertook efforts to patent about 130 acres in 27 claims on government land that was being used as tailings ponds. The firm also had to address control of heavy dust clouds from their tailings dumps during 1979.

Silver.—A sharp increase in both the quantity and value of silver produced in 1979 accompanied increases in copper output. The Santa Rita mine of Kennecott Copper Corp., the Tyrone mine of Phelps Dodge Corp., and UV Industries' Continental mine, all in Grant County, were the principal sources of silver-bearing copper ores. Output of silver was the highest in 5 years and the value, in consequence of increased output and a rise in the average price of silver from $5.04 an ounce to $11.09 an ounce in 1 year, was almost 210% higher than in 1978. During the biennium, 11 mines reported production of silver. Nine of the mines were in Grant County, and one each were in Catron, Hidalgo, and Sierra Counties. With the exception of the ores from the Kennecott and Phelps Dodge mines, the source materials were mixed sulfides of base metals including lead, zinc, and copper, with accompanying silver and gold. Challenge Mining Co.'s leach project in the Cooney mining district in Catron County anticipated recovery of silver with the gold from ores from the Eberle mine and dumps in the area. New Cinch Uranium, Ltd., also discovered 0.14 ounces of silver per ton with gold in the ore deposits they were exploring northwest of Orogrande.

Zinc.—Zinc was obtained principally from the Central mining district in Grant County from the same mixed sulfide ores that yielded lead, copper, gold, and silver. Following the closing of ASARCO's Ground Hog Unit in 1978, zinc production in 1979 declined abruptly as Ground Hog had provided more than 90% of the State's output. Prices of zinc dropped from an average unit value of $0.37 per pound in 1976 to about $0.31 per pound in 1978 followed by an increase to about $0.37 per pound in 1979. Although total production of zinc in the State dropped in 1978 and 1979, the output of zinc from the mines other than Ground Hog Unit increased by almost 250%. Seven mines were productive in 1978, but only four produced in 1979. UV Industries' Continental mine led in zinc production in 1979 by a wide margin over that of the Summit mine of Summit Minerals, the Volcano mine in Hidalgo County, and Dresser Industries, Inc., Center mine in Grant County.

Continental Oil Co. was reported to have plans to continue drilling a large high-grade deposit of sulfide minerals in the Pecos Mountains northeast and east of Santa Fe. Mineral intersections as much as 100 feet wide were found in coring, and reported assays showed as much as 7% zinc, 3% copper, and associated silver.

Other Metals.—UV Industries, Inc., produced magnetite iron ore as a byproduct of copper mining at the Continental mine near Fierro. Some of the magnetite was sold for use in heavy-media coal separation and cleaning. Most of the material was stockpiled. One firm reported production of a small amount of tin ore from a mine in Catron County in 1978. The mine was inactive in 1979. Produced vanadium as identified was a byproduct of the uranium mining industry. Production of vanadium in 1978 and 1979 followed an annual trend of decline from a 5-year high output established in 1976.

NONMETALS

Carbon Dioxide.—S.E.C. Corp. of El Paso, Tex., produced carbon dioxide from wells in Harding County. The gaseous carbon dioxide was piped to two plants near Mosquero where it was converted to dry ice in one plant and to liquid form in the other. Liquid carbon dioxide was sold to oil companies for use in enhanced recovery of crude petroleum. S.E.C. Corp. had previously operated a plant at Solano, but it was deactivated in 1979. Carbon dioxide resources on the Bravo Dome of Harding County, southern Union County, and northern Quay County are estimated to be more than 8 trillion cubic feet. During the biennium, oil companies were actively attempting to devise a plan whereby the carbon dioxide could be systematically recovered and shipped to oilfields in southeast New Mexico and west Texas to assist in the recovery of crude oil.

Cement.—Ideal Basic Industries, Inc., Ideal Cement Co., manufactured cement at Tijeras in eastern Bernalillo County. After experiencing a strong increase in output between 1975 and 1977, the quantity of cement shipped declined sharply in 1978 and even more sharply in 1979 to the lowest level in 5 years. Value of the shipped cement continued to rise into 1978 but turned downward in 1979. The plant produced general-purpose-moderate-heat, high-early-strength, and high-sulfate-resistance gray portland cement, and also masonry cement. The principal identified users of cement, in order of decreasing size of shipments, were ready-mix concrete companies, concrete-product manufacturers, building-material dealers, highway contractors, and government agencies. Unidentified miscellaneous customers and other contractors received total shipments that were somewhat greater than the quantity received by concrete-product manufacturers. Ideal Cement quarried limestone, mined clay and shale, and purchased sand and gypsum as raw materials for the manufacture of cement. Natural gas, coal, and electrical energy were required to operate the two dry-process kilns and the associated glass-bag air quality control system at the plant. Almost all of the cement was shipped by truck.

Clays.—Both quantity and value of clay produced reached 5-year highs in 1979 with a strong recovery from somewhat depressed output and value in 1978. The rebound in 1979 was in line with the general trend of annually increasing quantity and value after 1975. Clay output increased 68% between 1975 and 1979 as the value increased 103%. Both common clay and shale experienced this growth, and were mined during the biennium in Bernalillo County for the manufacture of face brick and for use in the manufacture of cement; in southeastern Dona Ana County for the manufacture of common brick in El Paso, Tex.; and near Farmington in San Juan County where the clay was used for the manufacture of roofing tile and other unspecified items. Fire clay was mined at one locality in northern Luna County and near Pratt in Hidalgo County. The fire clay was used in the manufacture of plugs and other refractory ware for use in smelters.

Gem Stones.—Turquoise, the State's principal gem stone, was mined at several localities. The mineral was available as raw and polished turquoise, and in native jewelry and art work.

Gypsum.—Maximum output and maximum output value of gypsum for the years 1975 through 1979 were experienced in the 1978 and 1979 biennium. Production in 1978 was about 230% above that of 1975, and in 1979 the value of output was more than 850% higher than that of 1975. Three companies supplied the total output. Duke City Gravel Products Co. and White Mesa Gypsum Co. had mines in Sandoval County. Western Gypsum Co. operated the Rosario mine in Santa Fe County. Calcined gypsum was prepared by the Susquehanna Corp., American Gypsum Division, in Albuquerque and by the Western Gypsum Co. The gypsum wallboard manufacturing plant at Rosario, N. Mex., was purchased from Kaiser Cement and Gypsum Corp. of Oakland, Calif., by Drywall Supply, Inc., of Denver, Colo. Western Gypsum Co., a subsidiary of Drywall, reopened the plant in June 1978, after it had been modernized to comply with State and Federal air quality standards. The combined output of gypsum board from American Gypsum Co. and Western Gypsum Co. was sufficient to supply local housing construction requirements.

Helium.—Western Helium Co. recovered high-purity helium from a mixture of nitrogen and helium obtained from the Tocito field in San Juan County. A somewhat fluctuating quantity of several million cubic feet of high-purity helium had been produced annually from 1975 through 1978. No production was recorded in 1979.

Lime.—Output of lime was declining entering the biennium, but the trend turned slightly upward in 1979. Value of the output, however, increased steadily from 1975 to a 5-year maximum in 1979, except for a minor reversal in 1978. The overall increase between 1975 and 1979 was almost $1.1 million. The increase between 1978 and 1979 exceeded $380,000. Mathis and Mathis Mining and Exploration Co. quarried limestone and produced lime at its plant several miles west of Hanover in Grant County. Kennecott Copper Corp., Chino Mines Division, converted locally quarried limestone to lime at its Hurley plant. The product was used in Chino's ore concentrator.

Mica.—Mineral Industrial Commodities of America mined mica near Taos in Taos County. Output of the material increased about 14% between 1977 and 1979. The mica ore was processed in the company's mill at Pojoaque in Santa Fe County.

Peat.—Humus Organic Products at San Ysidro in Sandoval County milled peat (humate) during the biennium. Output remained constant at about 2,000 tons per year, but the value of the output decreased about 30% in 1979.

Perlite.—In attaining production of 588,000 tons valued at $14.9 million in 1979, the perlite industry in New Mexico culminated 5 years of continuous growth in output and value of product. However, the increase of output of about 2% between 1978 and 1979 was the smallest yearly change recorded in the 5-year period. Conversely, value grew about 19% between 1978 and 1979. Perlite was produced by four companies that operated five mines and five plants. Grefco, Inc., mined and processed perlite near Socorro in Socorro County and in Taos County with Johns Manville Corp. and Silbrico Corp. United States Gypsum had a mine and plant northeast of Grant in Valencia County.

Potash.—After 3 years of almost static production and only slightly fluctuating prices, a strong market demand raised the price of potash fertilizers and stimulated mining of potash in 1978 and 1979. By 1979, production had increased about 6% above the essentially static level of output in 1975-77, as total value of the output increased about 35% in conjunction with increases in average unit value of potash from almost $90 per metric ton in 1977 to about $114 per metric ton in 1979. Seven companies mined potash in both years of the biennium. Eastern Eddy County had seven active mines and western Lea County had one mine, all of which were underground. Six of the firms followed conventional mining practice. Kerr-McGee Chemical Corp. mined with a continuous miner and Potash Co. of America applied both mining methods. More than 85% of the potash sold or used in both years was as muriate. The remainder included manure salts and potassium sulfates.

Average prices of most potash rose rapidly during the biennium. Manure salts, the exception, maintained average prices of less than $20 per metric ton. The average prices of all muriates, potassium sulfate, and potassium magnesium sulfate, rose about $20 per metric ton between 1978 and 1979. Average prices of muriates of various grades ranged from $86.80 per metric ton (granular) to $132.16 per metric ton (chemical) with the average of all muriates at $96.51 per metric ton in 1979. The average price of potassium salt in 1979 was almost $225 and that of potassium magnesium sulfate was about $215.50 per metric ton. AMAX Chemical Corp., Duval Corp., International Minerals & Chemical Corp., Kerr-McGee Chemical Corp., Mississippi Chemical Corp., and Potash Co. of America produced potash. Duval, International Minerals, and Potash Co. of America were the only producers of the high-value potassium and potassium magnesium sulfates that are widely in demand for manufacture of fertilizers. AMAX was the only firm that produced manure salt. All seven firms produced one or more of the muriates. Company reports indicated that reserves of potash held by AMAX at the end of 1979 were 73 million tons with an average potassium oxide content of 14%. Duval held 35,271,000 tons of proven recoverable langbeinite ore that had an average grade of 8.4% potassium oxide. This could be upgraded by washing to 12,188,000 tons of product containing 22% potassium oxide. International Minerals & Chemical Corp. reserves consisted of sufficient sylvinite ore (mixed sodium chloride and potassium chloride) to yield 17 million tons of potash containing 60.5% potassium oxide. Langbeinite ores held by the firm would yield 37 million tons of product with a 22% potassium oxide content. Potash Co. of America revealed that its reserves would sustain production at the 1979 rate for at least 9 years.

Operations in the industry were affected in several ways during the biennium. Potash Co. of America lost nearly a month's production when the rotor in the main hoist failed on August 30, 1979. Management at the Carlsbad branch of National Potash Co. was reorganized in October 1979. AMAX and Duval were both subject to strikes during mid-year 1978. Duval's new contract called for base-wage increases in 1978, 1979, and 1980; liberalized benefits on accident and health insurance coverage; and modified working conditions. During 1978, Duval Corp. also terminated mining and refining of sylvinite ore and the production of muriate of potash and closed the North mine and muriate refinery of potash because of reduced availability of ore and reduced ore grades. About 150 hourly and 50 salaried persons were severed. AMAX undertook construction of a 20-acre solar evaporation pond near Carlsbad in 1978. The $1.2 million facility was completed in 1979 with expectations of increasing production about 20,000 tons per year. The firm also increased its mining potential by installing two continuous miners as part of their ongoing program to upgrade the equipment in the mine. Duval completed a new prilling mill at Carlsbad in 1979. Products of the prilling mill were expected to be a specialized granular potassium magnesium sulfate and a suspension-grade potassium magnesium sulfate for use in liquid fertilizers.

Investigators at New Mexico State University, supported by a grant from the State Department of Energy and Minerals, undertook research to apply solar energy and energy conservation techniques in the refining of potash. The Potash Managers Council, which represents the seven firms that produce potash in New Mexico, endorsed the project.

Schedules for controlling particulate emissions for each of the companies were reviewed in May 1979, and found adequate to bring all companies except International Minerals & Chemical Corp. into compliance by 1982. The latter's compliance schedule was extended until 1984 in order to develop a solar evaporation system. Wet-scrubber processes, dry-cyclone collectors, and baghouse methods would be used in collecting particulate materials. Apparently, as a result of complaints from the State of Texas about salinity of the water in the Pecos River, the Bureau of Land Management activated a study of the hydrology and quality of the ground water in the vicinity of the potash mines and mills. The study found that effluents from the mills had locally increased the salinity of the ground water in underlying formations near the mills but it was unable to identify any communication of the effluent with the Pecos River. The study concluded that no drinkable water supplies had been degraded because the existing ground water was already saline in character.

In 1979, the Bureau of Mines released information about the potential impact of the Department of Energy's (DOE) Waste Isolation Pilot Plant (WIPP) on potash resources in salt beds at a proposed project site in Eddy County. The Bureau determined the value of the unmined potash reserves to be about $51.8 million. The resources contained, in addition, about 25.5 million tons of potash products in subeconomic form. Potential losses to the State in the event these resources are not produced were estimated to be $16.8 million in taxes and acquisition costs; more specifically, $5.9 million for the State's half of Federal royalties, $2.2 million in State royalties, $1.9 million in State income tax, $3.9 million in severance tax, and $2.8 million in acquisition costs. Values in the report are in 1977 dollars.

Table 7.—New Mexico: Production and sales of potassium salts

(Thousand metric tons and thousand dollars)

Period	Crude salts[1] mine production		Marketable potassium salts				
			Production		Sold or used		
	Gross weight	K_2O equivalent	Gross weight	K_2O equivalent	Gross weight	K_2O equivalent	Value[2]
1978:							
January-June	8,770	1,250	1,861	947	1,870	972	91,000
July-December	8,730	1,230	1,852	959	1,847	971	92,600
Total[3]	17,500	2,480	3,713	1,906	3,717	1,943	183,554
1979:							
January-June	8,660	1,190	1,852	931	2,047	1,053	114,700
July-December	8,693	1,208	1,783	934	1,826	960	114,100
Total[3]	17,353	2,398	3,635	1,865	3,873	2,005	228,776

[1] Sylvinite and langbeinite.
[2] F.o.b. mine.
[3] Data may not add to totals shown because of independent rounding.

Pumice.—The production of pumice, also described as scoria and volcanic cinders, entered the 1978-79 biennium on an increasing trend, but declined in 1979. The value of the product, however, continued to increase into 1979 when it reached approximately $3.5 million, which was 177% higher than it had been in 1975. Ten firms mined pumice in the biennium, utilizing 12 sites in 1978 and 13 in 1979. Union County was the leading source of pumice during both years. Santa Fe County and Rio Arriba County alternated as second and third most productive counties in consecutive years. Pumice was also mined in Dona Ana, Sandoval, San Juan, and Socorro Counties. Twin Mountain Rock Co., Morton Brothers Cinders and Stone, and General Pumice Corp. were the leading producers. Their combined production was more than 75% of the State's total pumice output in both years. The average disposition of produced pumice during the biennium was to concrete aggregate, 42.4%; landscaping, 25%; roofing, 2.4%; and various other uses, 30.2%. J.H. Rhodes and Co. of Santa Fe became American Pumice Co. in 1979.

Salt.—The largest quantity of salt sold or used by producers during the interval 1975 through 1979 was recorded in 1978. The value of salt sold or used in 1979, the highest in any year during the 5-year period, exceeded the 1978 value by $563,000 and the 1975 value by $900,000. Salt was produced in Catron County by Zuni Salt Lake Enterprises through solar evaporation of lake brine. Pioneer Water Co. in Lea County produced brine as did Potash Co. of America and Duval Corp. in Eddy County. United Salt Co. in Eddy County produced salt by solar evaporation brine.

Sand and Gravel.—As the most important natural building material produced in New Mexico in 1978 and 1979, sand and gravel was second in value only to potash among the nonmetallic mineral commodities. Output valued at $18.2 million in 1979 was the highest since 1975 and entailed an increase of about 32% above that of 1975. The trend of output differed somewhat during the 5 years, reaching a maximum in 1977 and then successively declining in 1978 and 1979. Bernalillo, Dona Ana, and San Juan Counties, the leading sources of sand and gravel, accounted for about 60% of the total State production in 1978. Much of the sand and gravel produced in the three counties was for construction needs of Albuquerque, Las Cruces, El Paso, Tex., and Farmington. Counties in which 250,000 to 500,000 tons of sand and gravel were produced included Santa Fe, with its associated construction demands in the city of Santa Fe; Chaves County, with the requirements for Roswell; Eddy County, containing Carlsbad; and Lea County, with its growing communities of Lovington and Hobbs. In all, sand and gravel was produced in 26 counties. The output in 1978 was achieved by 78 producing firms which utilized 91 deposits. Eight of the firms provided more than one-half of the total output. Many of the individual mining operations were relatively small. Thirty-five operations produced less than 50,000 tons each in 1978. Tonnages between 50,000 and 100,000 were attained by 21 firms. Sixteen firms each produced between 100,000 and 200,000 tons of sand and gravel. Four firms produced between 300,000 and 400,000 tons of product. The maximum output in the range of 1 to 1.5 million tons was recorded by only two sand and gravel companies. Production statistics for the industry during 1979 are similar to those of 1978. The quantities of sand and gravel specifically utilized were about 55% for aggregate, 26% roadbase, 10% fill, 5% for concrete products, about 2% for plaster and gunite sands, a minute quantity for snow and ice control, and nearly 2% for all other uses. With some minor changes, the distribution by uses was essentially similar in 1979. Trucks hauled almost 92% of the product in 1978 and about 97% in 1979. About 0.5% went by rail and nearly 8% was used onsite in 1978. No rail transport was reported in 1979.

Table 8.—New Mexico: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,870	$9,158	$2.37	3,522	$8,475	$2.41	2,765	$7,222	$2.61
Plaster and gunite sands	NA	NA	NA	186	608	3.27	209	789	3.77
Concrete products	488	1,078	2.21	377	858	2.28	407	854	2.35
Asphaltic concrete	1,698	3,385	1.99	1,014	2,409	2.38	770	2,669	3.47
Roadbase and coverings	1,929	3,286	1.71	2,142	4,029	1.88	2,339	5,545	2.37
Fill	543	616	1.13	855	985	1.15	571	792	1.39
Snow and ice control	NA	NA	NA	2	6	3.74	--	--	--
Railroad ballast	10	40	4.00	--	--	--	--	--	--
Other uses	65	115	1.76	142	483	3.41	80	274	3.42
Total[1] or average	8,604	17,685	2.06	8,239	17,850	2.17	7,141	18,245	2.55

NA Not available.

[1] Data may not add to totals shown because of independent rounding.

Table 9.—New Mexico: Construction sand and gravel sold or used by producers

	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	3,002	$6,086	$2.03	3,495	$7,452	$2.13	2,919	$7,495	$2.56
Gravel	5,602	11,599	2.07	4,743	10,401	2.19	4,222	10,760	2.55
Total[1] or average	8,604	17,685	2.06	8,239	17,850	2.17	7,141	18,245	2.55

[1] Data may not add to totals shown because of independent rounding.

Stone.—Stone (crushed and dimension) ranked second in tonnage among raw nonmetal minerals produced in 1978 and 1979 and fourth in value of product. Both production and value of stone continued to rise during the biennium and reached a maximum output of almost 2.6 million tons valued at nearly $6.9 million in 1979. This was the highest output and value in any of the years from 1975 through 1979. Both crushed stone and dimension stone were produced. Crushed stone attained a maximum unit value of about $2.60 per ton in 1979. The maximum value of dimension stone, about $6.40 per ton in 1978, diminished somewhat in 1979. Stone was produced in 20 counties during the biennium. The leading sources were Bernalillo, Guadalupe, Lea, and McKinley Counties, which supplied more than 71% of the tonnage and about 68% of the value during both years. Output in each of the leading counties was more than 250,000 tons per year. In 1979, the year of greatest productivity, the State had 23 stone producers and 36 active quarries scattered through 19 counties. Most quarries had typically small annual outputs. In 1979, 26 quarries supplied less than 100,000 tons each, and of the 26 quarries, 18 were the sources of less than 25,000 tons each. Only one quarry produced more than 500,000 tons of stone. Eight quarries had production ranging from 100,000 to 200,000 tons, and the remaining quarry was in the range 400,000 to 500,000 tons. The 26 small quarries provided 27% of all stone produced in New Mexico in 1979. Almost 40% of the stone was produced in the eight quarries in the 100,000- to 200,000-ton annual range.

Quarrying yielded two types of products, crushed and dimension stone. The former included more than 99% of produced stone in both years. The largest use of crushed stone, about 18%, was for aggregates. Dense-graded roadbase and fill each required about 12% of the crushed stone. Requirements for concrete products, roadstone, manufacture of lime, preparation of stone sand, and filter stone were smaller. About 41% of all crushed stone was used by industries in which the individual company statistics were proprietary and could not be specifically identified (such as in the manufacture of cement). Limestone, granite, marble, sandstone, traprock, and other rock varieties were quarried. Both limestone and sandstone were used as crushed rock and dimension stone. Granite and traprock were used only as crushed stone. Marble was quarried only for dimension stone. Terrazzo was one of the uses for other stone. During the biennium, limestone was produced in the largest quantities from quarries in 14 counties, and was the leading stone product in Bernalillo, Lea, and McKinley Counties. A large part of the limestone produced in Bernalillo County was used in the manufacture of cement. Sandstone was the second most abundantly produced stone; its main source was Guadalupe County. Flux stone for smelting was quarried in Hidalgo County, and dimension stone was produced in Luna County. Traprock was produced in Dona Ana, McKinley, and Taos Counties. Granite was produced only in Taos County. The two sources of marble were in Bernalillo and Dona Ana Counties.

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[3] Address inquiries and requests to New Mexico Bureau of Mines and Mineral Resources, Publications, Room 107, Campus Station, Socorro, N. Mex. 87801.

Table 10.—New Mexico: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate	[r]98	[r]200	152	394	179	525
Bituminous aggregate	221	437	201	377	285	643
Macadam aggregate	--	--	W	51	--	--
Dense-graded roadbase stone	233	465	207	403	450	949
Surface treatment aggregate	26	147	144	577	99	307
Other construction aggregate and roadstone	187	312	229	387	351	901
Riprap and jetty stone	W	W	W	W	59	127
Filter stone	4	9	W	W	W	W
Manufactured fine aggregate (stone sand)	20	20	--	--	W	W
Lime manufacture	133	W	123	W	127	W
Flux stone	W	W	W	W	166	563
Fill	228	346	474	W	W	543
Other uses[2]	801	[r]2,849	907	3,968	873	2,185
Total[3]	1,950	4,786	2,438	6,157	2,589	6,743

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, sandstone, traprock, and miscellaneous stone.

[2] Includes stone used for railroad ballast, terrazzo, exposed aggregate, cement manufacture, and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Carbon dioxide (natural):			
S.E.C. Corp	Box 9737 El Paso, TX 79987	Wells and liquefaction and solidification extraction plant.	Harding.
Cement:			
Ideal Basic Industries, Inc., Ideal Cement Co.[1 2]	420 Ideal Cement Bldg. Denver, CO 80202	Dry process, 2 rotary kiln plants.	Bernalillo.
Clays:			
El Paso Brick Co	Box 12336 El Paso, TX 79912	Open pit mine	Dona Ana.
Kinney Brick Co., Inc	Box 1804 Albuquerque, NM 87102	do	Bernalillo.
Copper:			
Kennecott Copper Corp., Chino Mines Div.[2 3 4 5 6]	Hurley, NM 88043	Open pit mine, flotation mill, precipitation plant, smelter.	Grant.
Phelps-Dodge Corp., Tyrone Branch[3 5 7 8]	Drawer B Tyrone, NM 88065	Open pit mine and mill	Do.
UV Industries, Inc.[3 5 7 8]	136 East South Temple St. Salt Lake City, UT 84111	Underground mine, open pit mine, flotation mill.	Do.
Gypsum:			
Drywall Supply, Inc., Western Gypsum Co.	Box 2636 Sante Fe, NM 87501	Open pit and plant	Sante Fe.
Duke City Gravel Products Co	Gun Club Rd., SW Albuquerque, NM 87105	Open pit	Sandoval.
White Mesa Gypsum Co	124 Jackson, NE Albuquerque, NM 87108	do	Do.
Lead:			
ASARCO, Inc	Box 186 Vanadium, NM 88773	Underground mine, shaft,	Grant.
Lime:			
Mathis & Mathis Mining and Exploration Co.	1101 Santa Rita Silver City, NM 88061	Quay, open pit mine	Do.
Mica:			
Mineral Industries Commodities of America, Inc.	Box 2408 Santa Fe, NM 87501	Open pit mine	Taos.
Molybdenum:			
Union Oil Co. of California, Molycorp Div.	Box 760 Los Angeles, CA 90051	Open pit mine and flotation mill.	Do.
Perlite:			
Grefco, Inc., Dicalite	333 North Michigan Ave. Chicago, IL 60601	Open pit mine; crushing, screening, and air separation.	Socorro and Taos.
Johns-Manville Perlite Corp	2500 Miguelito Rd. Lompoc, CA 94336	do	Taos.

See footnotes at end of table.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Potash:			
AMAX Chemical Corp	Box 279 Carlsbad, NM 88220	Underground mine and refinery.	Eddy.
Penzoil Co., Duval Corp.[9]	Box 511 Carlsbad, NM 88220	2 underground mines and refinery.	Do.
International Minerals & Chemical Corp.	Box 71 Carlsbad, NM 88220	Underground mine	Do.
Kerr-McGee Corp	Kerr-McGee Bldg. Oklahoma City, OK 73102	do	Do.
Mississippi Chemical Co	Box 101 Carlsbad, NM 88220	1 underground mine	Do.
National Potash Co	Box 731 Carlsbad, NM 88220	do	Lea.
Ideal Basic Industries, Inc., Potash Co. of America.[9]	Box 31 Carlsbad, NM 88220	do	Eddy.
Pumice:			
Beatrice Foods, American Pumice Co.	Box 4305 Santa Fe, NM 87502	Processing plant	Santa Fe.
General Pumice Corp	Box 449 Santa Fe, NM 87501	Open pit mine and crushing and screening plant.	Rio Arriba.
Morton Bros	Box 2000 Las Cruces, NM 88001	do	Dona Ana.
Twin Mountain Rock Co	Box 1009 Sheridan, WY 82801	do	Union.
Salt:			
United Salt Corp	Box SS, Carlsbad, NM 88220	Salt lake	Lea.
Sand and gravel (commercial):			
Albuquerque Gravel Products	Box 829 Albuquerque, NM 87103	Dredge and plant	Bernalillo.
Armstrong and Armstrong Contractors.	South Sunset Ave. Roswell, NM 88201	Pit and portable plant	Chaves.
Colony Materials	Box 4096 Santa Fe, NM 87501	Pit and plant	Santa Fe.
Espanola Transit Mix Co	Box 38 Espanola, NM 87532	do	Rio Arriba.
Rose Gravel Co	1400 San Jose Blvd. Carlsbad, NM 88220	do	Eddy.
San Juan Concrete Co	507 South Behrend Ave. Farmington, NM 87401	do	San Juan.
Springer Building Materials Corp	Box 572 Albuquerque, NM 87103	Pit and stationary crushing and screening plant.	Bernalillo.
Valley Transit Mix, Inc	East Lohman Ave. Las Cruces, NM 88001	Dredge and plant	Dona Ana.
Stone:			
Apache Spring Co	Box 48 Radium Springs, NM 88054	Quay	Do.
Constructors, Inc	3001 South Boyd Dr. Carlsbad, NM 88220	Quarry, portable crusher, hot mix plant.	Eddy.
Gallup Sand and Gravel Co	Box 1119 Gallup, NM 87301	Quarry, crusher	McKinley.
Hamilton Bros., Inc	3100 East Aztec Ave. Gallup, NM 87301	Quarry, crusher, hot mix plant.	Do.
Kent Nowlin Construction, Inc	Box 14654 Albuquerque, NM 87111	Quarries and portable crushers.	Guadalupe, Lincoln, McKinley, Quay, San Juan, Santa Fe.
Rocky Mountain Stone Co	Box 6608 Albuquerque, NM 87107	Quarries	Socorro and Valencia.
Thomasen Construction Co	1201 West Bender Blvd. Hobbs, NM 88240	Quarry and portable crusher.	Lea.

[1] Also clays.
[2] Also stone.
[3] Also gold.
[4] Also molybdenum.
[5] Also silver.
[6] Also lime.
[7] Also lead.
[8] Also zinc.
[9] Also salt.

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The Mineral Industry of New York

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the New York Geological Survey, for collecting information on all nonfuel minerals.

By William Kebblish[1]

The total value of minerals produced in New York was $418.5 million in 1978 and $453.7 million in 1979. The five commodities that contributed nearly 90% of the total value were cement, lime, salt, stone, and sand and gravel. Other minerals included clays, gypsum, iron ore, talc, titanium, and various abrasives. Silver and lead were produced as a byproduct of zinc processing, while slag and sulfur were recovered from other operations.

Table 1.—Nonfuel mineral production in New York[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2] thousand short tons	564	$1,728	659	$2,121	836	$3,027
Gem stones	NA	15	NA	20	NA	20
Lead (recoverable content of ores, etc.) metric tons	2,520	1,706	990	735	458	532
Peat thousand short tons	39	569	49	770	38	630
Salt do	6,452	72,623	5,879	77,236	6,387	77,751
Sand and gravel do	29,197	57,570	[3]28,760	[3]59,280	[3]26,242	[3]55,889
Silver (recoverable content of ores, etc.) thousand troy ounces	56	260	21	118	11	117
Stone:						
Crushed thousand short tons	29,922	88,509	35,748	98,530	36,901	112,362
Dimension do	25	2,272	25	2,586	27	2,626
Zinc (recoverable content of ores, etc.) metric tons	64,264	48,737	26,463	18,086	12,133	9,977
Combined value of cement, clays (ball clay), emery, garnet (abrasive), gypsum, iron ore, lime, sand and gravel (industrial, 1978-79), talc, titanium concentrate (ilmenite), and wollastonite	XX	163,726	XX	159,065	XX	190,779
Total	XX	437,715	XX	418,542	XX	453,710

NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes ball clay; value included in "Combined value" figure.

[3] Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in New York, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Albany	W	W	Cement, stone, clays, sand and gravel.
Allegany	$1,463	$1,147	Sand and gravel.
Broome	W	W	Sand and gravel, clays, peat.
Cattaraugus	4,208	W	Sand and gravel, peat.
Cayuga	W	W	Sand and gravel, stone.
Chautauqua	981	882	Sand and gravel.
Chemung	878	1,529	Do.
Chenango	657	607	Do.
Clinton	873	W	Stone, sand and gravel.
Columbia	8,266	W	Sand and gravel, stone.
Cortland	832	1,041	Sand and gravel.
Delaware	W	1,885	Stone, sand and gravel.
Dutchess	W	W	Stone, sand and gravel, peat.
Erie	W	W	Stone, lime, sand and gravel.
Essex	13,336	12,233	Wollastonite, iron ore, titanium concentrate, stone, sand and gravel, garnet.
Franklin	W	W	Stone, sand and gravel.
Fulton	320	343	Sand and gravel.
Genesee	W	W	Gypsum, stone, sand and gravel.
Greene	W	W	Cement, stone, sand and gravel.
Hamilton	24	--	
Herkimer	W	W	Sand and gravel, stone.
Jefferson	2,604	3,390	Stone, sand and gravel.
Lewis	W	W	Stone, sand and gravel, wollastonite.
Livingston	W	W	Salt, stone, sand and gravel.
Madison	1,453	1,763	Stone, sand and gravel.
Monroe	W	W	Do.
Montgomery	1,619	W	Do.
Nassau	W	W	Sand and gravel, clays.
Niagara	W	W	Stone.
Oneida	W	W	Sand and gravel, stone.
Onondaga	45,138	44,122	Lime, stone, salt, cement, sand and gravel, clays.
Ontario	W	W	Sand and gravel, stone.
Orange	2,763	W	Sand and gravel, stone, peat, clays.
Orleans	W	1,068	Stone, sand and gravel.
Oswego	1,799	1,742	Sand and gravel.
Otsego	347	297	Do.
Putnam	W	W	Stone.
Rensselaer	W	W	Sand and gravel, stone.
Rockland	W	W	Stone, sand and gravel.
St. Lawrence	69,898	27,259	Zinc, iron ore, talc, stone, sand and gravel, lead, silver.
Saratoga	3,225	3,271	Stone, sand and gravel.
Schenectady	536	W	Sand and gravel.
Schoharie	W	W	Cement, stone, sand and gravel.
Schuyler	W	W	Salt, sand and gravel.
Seneca	W	W	Stone, peat, sand and gravel.
Steuben	W	W	Sand and gravel, stone.
Suffolk	4,809	5,100	Sand and gravel.
Sullivan	W	W	Stone, sand and gravel.
Tioga	1,245	1,563	Sand and gravel.
Tompkins	W	W	Salt, stone, sand and gravel.
Ulster	W	W	Cement, stone, sand and gravel, clays.
Warren	10,829	12,157	Cement, garnet, stone, sand and gravel.
Washington	1,539	1,799	Stone, sand and gravel.
Wayne	W	W	Do.
Westchester	305	302	Sand and gravel, emery, stone, peat.
Wyoming	W	W	Salt, sand and gravel.
Yates	330	158	Sand and gravel.
Undistributed[2]	257,437	294,883	
Total[3]	437,715	418,542	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Bronx, Kings, New York, Queens, and Richmond Counties are not listed because no nonfuel mineral production was reported.

[2] Includes gem stones, sand and gravel, and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of New York business activity

	1977	1978	1979^p	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force ... thousands	7,756.0	7,838.0	8,009.0	+2.2
Unemployment ... do	707.0	603.0	507.0	-5.5
Employment (nonagricultural):				
Mining[1] ... do	6.9	6.3	5.9	-6.4
Manufacturing ... do	1,459.6	1,481.2	1,498.9	+1.2
Contract construction ... do	190.2	199.2	206.6	+3.7
Transportation and public utilities ... do	425.3	430.3	433.7	+0.8
Wholesale and retail trade ... do	1,427.6	1,454.7	1,476.0	+1.5
Finance, insurance, real estate ... do	577.8	586.9	603.0	+2.7
Services ... do	1,499.5	1,570.6	1,635.4	+4.1
Government ... do	1,270.8	1,316.0	1,315.2	+.1
Total nonagricultural employment[1] ... do	[2]6,857.6	7,045.2	[2]7,174.6	+1.8
Personal income:				
Total ... millions	$133,653	$146,059	$160,555	+9.9
Per capita ...	$7,453	$8,230	$9,098	+10.5
Construction activity:				
Number of private and public residential units authorized ...	39,645	[3]43,132	32,928	-23.7
Value of nonresidential construction ... millions	$642.9	$1,020.8	$823.3	-19.4
Value of State road contract awards ... do	$500.0	$525.0	$445.0	-15.2
Shipments of portland and masonry cement to and within the State thousand short tons	2,345	2,622	2,682	+2.3
Nonfuel mineral production value:				
Total crude mineral value ... millions	$437.7	$418.5	$453.7	+8.4
Value per capita, resident population ...	$24	$24	$26	+8.3
Value per square mile ...	$8,829	$8,442	$9,152	+8.4

^{p}Preliminary.

[1] Includes oil and gas extraction.

[2] Data do not add to total shown because of independent rounding.

[3] Series revised in 1978, data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Trends and Developments.—A period of change occurred for metal producers during 1978 and 1979. Jones & Laughlin Steel Corp.'s iron ore mine in St. Lawrence County was closed because of economic conditions, leaving only one open pit iron ore mine in operation. New York's only zinc mines, operated by St. Joe Minerals Corp., were idle for a 13-month period owing to a work stoppage. Operations at St. Joe's Balmat and Edwards underground zinc mine resumed in July 1979 with a reduced work force because of imports that affected the domestic zinc industry. Production of silver and lead, a byproduct of zinc mining, also decreased.

Employment.—According to the Mine Safety and Health Administration, a total of 7,731 workers were employed in New York's metal and nonmetal mining industries in 1978. Underground employees totaled 737; surface employees, 3,263; mill employees, 2,670; and office staff, 1,061. The sand and gravel industry, with 2,163 employees, ranked first in number of employees, followed by the stone industry, with 1,891 employees.

Legislation and Government Programs.—The 1975 Freshwater Wetlands Act regulated activities on wetlands of 12.4 acres or more, as well as activities within 100 feet of the vegetative boundary of each wetland. Regulated activities included mining, dredging, excavating, dumping, and filling. The Department of Environmental Conservation (DEC) enforced the Act, and in order to assist landowners, prepared topographical maps identifying wetland areas. In late 1979, DEC was reorganized, making permits more available to landowners and providing local governing bodies with more jurisdiction in local affairs.

The State completed its fourth year of work on the Coastal Zone Management Program, funded by the Federal Office of Coastal Zone Management (OCZM). A draft program, containing legislative plans, with strategy for implementation, was submitted in October 1979 for preliminary OCZM review. The Coastal Zone Program regulates land use policies, including mining, in the coastal zone.

A comprehensive statewide resource recovery and solid waste management plan calls for processing over 60% of the State's solid waste by 1985. Currently, a number of city and county waste recovery facilities are under construction for recovery of glass, ferrous and nonferrous metals, and refuse-derived fuel. Some facilities have been designed to generate power needed for operations.

The New York Department of Transportation's Materials Bureau has been cooperating with the New York Geological Survey to define the chemical and physical characteristics of carbonate bedrock formations, in search of more suitable aggregate for road-building purposes. Properties sought were greater durability and improved nonskid qualities. Over 1,400 core samples have been analyzed, with laboratory analyses funded by the Federal Bureau of Mines. The results will be published.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives, Manufactured.—Types of manufactured abrasives included fused aluminum oxide, fused alumina zirconia, and silicon carbide; these were used in the manufacture of steel shot and grit, cut wire shot, and stainless steel cut wire. Expansion of the Niagara Falls plant operated by General Abrasives Division of Dresser Industries is expected to increase employment from 225 to 275 employees, with completion set for 1981. Kennecott Copper Corp. of New York purchased the Carborundum Co. of Niagara Falls at a cost of $567 million in early 1978.

Calcium Chloride.—Allied Chemical Corp. recovered synthetic calcium chloride as a byproduct of soda ash at the company's Syracuse plant in Onondaga County. Production remained constant through 1978 and 1979, but value increased approximately 18% annually because of inflationary pressures. The principal use for calcium chloride was in ice and snow removal. It was also used as a dust suppressant, especially on underground mine haulage roadways.

Cement.—New York ranked 6th nationally in the production of portland cement and 24th in the production of masonry cement in 1978 and 1979. Portland cement shipments from eight plants in six counties in 1979 decreased 2% in quantity but increased 14% in value, compared with 1978 shipments, with an average increase of $4.63 per short ton.

In 1979, ready-mixed-concrete companies used 40% of the portland cement produced, while building material dealers used 34%. Concrete product manufacturers and highway contractors used the remaining output. Truck transportation accounted for 77% of the portland cement moved to market; other transportation included barge and rail.

Masonry cement was produced by two companies in two counties. In 1979, production decreased over 6%, but value increased 15%, compared with 1978 levels, with an average increase of $8.90 per short ton. Masonry cement shipped by producers in the New York-Maine district averaged $45.15 per short ton in 1979.

Atlantic Cement Co., Ravena, Albany County, received the National Environmental Industry Award for demonstrating outstanding achievement and leadership in areas of pollution abatement and protection of the environment. The Atlantic Cement plant was also cited for excellent community relations and environmental practices, and was awarded the Flag of Achievement by the Environmental Protection Agency.

Clays.—Clay and shale produced in 1979, excluding ball clay, totaled 836,000 short tons valued in excess of $3 million; both quantity and value were higher than those of 1978. Common clay and shale were produced by 11 companies in 6 counties. Producing companies included Atlantic Cement Co., Norlite Corp., Nassau Brick Co., Inc., General Dynamics, and Binghamton Brick Co., Inc. The two leading counties producing clay and shale were Albany and Ulster; other counties included Broome, Nassau, Onondaga, and Orange.

Clay and shale were used mainly in the manufacture of portland cement, lightweight aggregate, common brick, and pottery. The average unit price was $3.22 per short ton in 1978 and approximately $3.62 in 1979.

Emery.—The entire U.S. production of emery was recovered by De Luca Emery

Mine, Inc., and Emeri Crete, Inc.; both have open-pit mines near Peekskill, Westchester County. Domestic emery was used mainly in aggregates as a nonslip additive for floors, pavements, and stair treads.

Garnet.—New York ranked second to Idaho in the production of garnet in 1978 but dropped to third in 1979. Garnet was produced at the Barton Mines Corp. mine on Gore Mountain, Warren County, but reserves are nearly depleted. The company received permission from State agencies to open a mine and build a new mill on Ruby Mountain, approximately 3.5 miles northwest of Gore Mountain. Reserves of garnet on Ruby Mountain are expected to last for the next 25 years. Garnet was also recovered as a byproduct of wollastonite mining by Interpace Corp. in Essex County; it was used in coated abrasives, glass grinding and polishing, and metal lapping.

Gem Stones.—The collecting of gem stones and mineral specimens was mainly by amateurs. Value of gem stones was approximately $20,000 in 1978, as well as in 1979. A favorite gem-collecting region was the Barton Mines Corp. garnet mine on Gore Mountain, a few miles north of North Creek.

Graphite, Manufactured.—New York led the Nation in 1979, producing nearly 128,000 short tons of synthetic graphite valued in excess of $121 million. Graphite manufactured from petroleum coke and other materials was produced by Great Lakes Carbon Corp., Airco Speer Electronics, Carborundum Metals Co., and Union Carbide Corp. The principal use was for graphite shapes, including anodes, electrodes, electric motor brushes, and crucibles. Synthetic graphite powder was used in steelmaking, as an additive in nonferrous metallurgy, for foundry facings, and in lubricants.

Gypsum.—United States Gypsum Co., Genesee County, was the only producer of crude gypsum in the State. This gypsum, together with that mined in other States, was calcined at five plants in the counties of Bronx, Erie, Genesee, Rockland, and Westchester. Calcined gypsum production totaled 1.2 million short tons valued at $48 million in 1979, a slight decrease in quantity but a 22% increase in value, compared with the 1978 figures. Principal uses for calcined gypsum were in the manufacture of wallboard and lath, and in the formulation of various types of plasters. Other uses were in the manufacture of pottery, glass, and industrial molding.

The Gold Bond Building Products Division of National Gypsum Co. relocated its headquarters from Buffalo to Charlotte, N.C., in the fall of 1978. The move, which affected about 360 employees, was attributed to preferred location near the high-growth market areas of the South and Southeast.

Lime.—Bethlehem Steel Corp., Erie County, and Allied Chemical Corp., Onondaga County, produced quicklime for use in alkalies and steelmaking. In 1978, production and value decreased 19% and 20%, respectively, compared with the 1977 figures, but this trend was reversed in 1979, with production nearly equal to that of 1977. Primary reason for the decline in quicklime in 1978 was the drop in production of caustic soda and soda ash. Quicklime accounted for 94% of the total output, and hydrated lime for the remainder. In addition to the lime produced in the State, a total of 935,000 short tons of lime was shipped into the State in 1978 and used by the producers or sold to various consumers.

In March 1979, United States Steel Corp. announced the closing of its 69-year-old limestone processing plant in Buffalo, affecting 20 employees. Reasons given by the company included escalating costs and environmental controls.

Peat.—Production and value of peat in 1979 decreased 23% and 18%, respectively, compared with that in 1978. Seven companies produced peat in six counties. Producers were Anderson Peat Co., Inc., Dutchess County; Finger Lakes Peat Moss Co., Seneca County; Good Earth Organics Corp., Cattaraugus County; Malcuria Bros., Inc., Seneca County; Bob Murphy, Inc., Broome County; Sterling Forest Peat Co., Inc., Orange County; and Stone Age Humus Corp., Westchester County. Kinds of peat produced were reed sedge and humus. Peat was generally used for soil improvement and as an ingredient in potting soils.

Perlite.—Crude perlite mined in other States was expanded at plants operated by Buffalo Perlite Co., Erie County; U.S. Gypsum Co., Genesee County; and Scolite International Corp., Rensselaer County. Production of expanded perlite remained relatively unchanged from 1978 to 1979. The most important use was in lightweight acoustical building plaster. Other uses included loose-fill insulation, soil conditioning, and filtration.

Salt.—Salt sold or used by producers in

1979 totaled 6.4 million short tons valued at $78 million, reflecting increases of nearly 9% in quantity and less than 1% in value, compared with the 1978 figures. Salt was produced in five counties by five companies in seven locations. Producing companies were Allied Chemical Corp., Cargill, Inc., Hooker Chemical Corp., International Salt Co., and Morton Salt Co. Schuyler and Wyoming Counties each had two salt plants; Livingston, Onondaga, and Tompkins Counties had one each. Most evaporated salt produced was used for the manufacture of soda ash, chlorine, and other chemicals. The principal use of rock salt was for ice control on highways.

Sand and Gravel.—Production of construction sand and gravel in 1979 totaled 26.2 million short tons valued at $55.9 million, averaging $2.13 per short ton, a decrease in both production and value compared with the 1978 figures. A total of 368 companies were operating in 1979, 65 fewer than in 1978. Principal producers were Buffalo Slag Co., Colonial Sand and Stone Co., Inc., and General Crushed Stone Co. Leading producing counties included Dutchess, Erie, Oneida, Rensselaer, and Suffolk. Construction sand and gravel was used mainly for roadbase, concrete aggregate, and fill.

Production of industrial sand from 1978 to 1979 decreased 50%, but value increased 34%. Industrial sand was used for glassmaking, moldings, and foundry purposes.

Table 4.—New York: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	9,032	$23,473	$2.60	8,029	$20,463	$2.55	6,107	$16,837	$2.76
Plaster and gunite sands	NA	NA	NA	140	483	3.45	162	571	3.53
Concrete products	1,045	2,422	2.32	989	2,262	2.29	862	2,173	2.52
Asphaltic concrete	4,934	9,836	1.99	4,311	9,796	2.27	3,962	9,910	2.50
Roadbase and coverings	7,896	14,001	1.77	9,147	17,161	1.88	8,627	15,969	1.85
Fill	5,557	5,988	1.08	4,408	5,142	1.17	4,225	5,316	1.26
Snow and ice control	NA	NA	NA	953	1,858	2.05	1,360	2,551	1.88
Railroad ballast	37	82	2.19	2	6	2.57	11	17	1.60
Other uses	562	1,004	1.79	777	2,005	2.58	928	2,545	2.74
Total[1] or average	29,063	56,804	1.95	28,760	59,280	2.06	26,242	55,889	2.13

NA Not available.
[1] Data may not add to totals shown because of independent rounding.

Table 5.—New York: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	13,467	$26,493	$1.97	12,497	$25,416	$2.03	11,846	$25,022	$2.11
Gravel	15,596	30,311	1.94	16,258	33,859	2.08	14,396	30,867	2.14
Total[1] or average	29,063	56,804	1.95	28,760	59,280	2.06	26,242	55,889	2.13
Industrial sand	134	766	5.71	W	W	W	W	W	W
Grand total or average	29,197	57,570	1.97	W	W	W	W	W	W

W Withheld to avoid disclosing company proprietary data.
[1] Data may not add to totals shown because of independent rounding.

Table 6.—New York: Construction sand and gravel sold or used, by county

(Thousand short tons and thousand dollars)

County	1977			1978			1979		
	Quantity	Value	Number of companies	Quantity	Value	Number of companies	Quantity	Value	Number of companies
Albany	158	192	5	176	258	3	116	169	3
Allegany	658	1,463	8	538	1,147	7	571	1,277	8
Broome	1,026	2,159	12	1,021	2,272	12	461	1,299	8
Cattaraugus	2,016	4,208	14	1,482	3,500	14	2,157	4,766	12
Cayuga	167	373	8	119	306	5	93	226	4
Chautauqua	513	981	9	421	882	7	392	877	7
Chemung	510	878	3	681	1,529	3	594	1,559	3
Chenango	338	657	6	260	607	5	279	695	6
Clinton	73	184	3	242	594	5	263	649	5
Columbia	515	883	4	347	598	3	232	431	3
Cortland	389	832	5	392	1,041	5	389	1,046	5
Delaware	26	33	3	79	211	3	70	168	3
Dutchess	1,848	3,612	39	2,602	6,196	39	2,357	6,827	31
Erie	781	2,104	8	1,181	3,174	8	1,162	3,632	8
Essex	780	1,189	19	517	799	19	729	1,067	17
Franklin	W	W	2	W	W	2	14	61	1
Fulton	197	320	4	183	343	3	242	438	3
Genesee	220	387	6	300	571	6	280	537	5
Greene	12	20	1	7	11	1	W	W	1
Hamilton	22	24	1	--	--	--	--	--	--
Herkimer	543	933	5	625	961	5	563	914	4
Jefferson	584	1,012	18	700	1,362	22	443	869	19
Lewis	292	488	7	286	485	6	281	487	4
Livingston	691	1,268	16	797	1,500	16	732	1,464	13
Madison	109	161	4	161	264	5	152	197	4
Monroe	1,152	1,967	12	1,027	1,928	11	1,105	2,045	10
Montgomery	68	115	3	W	W	2	W	W	2
Nassau	W	W	1	W	W	1	W	W	1
Oneida	739	1,180	13	847	2,336	14	742	1,315	10
Onondaga	660	1,193	6	684	1,282	4	594	1,166	4
Ontario	1,241	2,063	23	1,220	2,089	25	1,009	1,640	19
Orange	827	1,458	13	845	1,926	14	560	1,373	10
Orleans	268	452	3	268	452	3	W	W	2
Oswego	884	1,799	13	881	1,742	9	691	1,487	9
Otsego	225	347	4	158	297	3	177	285	3
Rensselaer	511	1,230	8	1,764	2,806	9	1,920	2,824	6
Rockland	W	W	2	W	W	2	W	W	2
St. Lawrence	421	615	12	560	882	13	312	495	9
Saratoga	356	596	6	249	431	5	134	390	4
Schenectady	313	536	3	W	W	1	W	W	1
Schoharie	12	14	1	7	14	1	7	8	1
Schuyler	166	274	9	185	315	9	51	71	6
Seneca	7	11	3	10	14	3	6	7	2
Steuben	964	1,986	11	714	1,957	10	697	1,967	10
Suffolk	2,597	4,809	17	2,461	5,100	19	2,635	4,977	16
Sullivan	205	466	7	164	556	5	181	414	5
Tioga	691	1,245	12	756	1,563	12	742	1,561	12
Tompkins	219	393	10	184	374	8	147	316	7
Ulster	406	672	7	236	393	7	195	372	5
Warren	10	15	2	10	15	2	W	W	1
Washington	244	417	3	257	451	4	92	148	4
Wayne	556	887	21	565	924	20	502	757	17
Westchester	W	W	2	W	W	2	W	W	2
Wyoming	207	359	3	223	375	3	48	76	3
Yates	176	330	8	81	158	8	75	146	8
Total[1]	29,063	56,804	448	28,760	59,280	433	26,242	55,889	368

W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Slag.—New York ranked ninth nationally in the production of slag. Producers were Buffalo Slag Co. and Harsco Corp., both in Buffalo. Slag, a product of iron and steelmaking operations, is classified as either steel slag or iron blast furnace slag. Steel slag was used mainly for roadbase and fill, while iron blast furnace slag went mostly into roadbase, asphaltic concrete aggregate, fill, and railroad ballast.

Stone.—Nationally, New York ranked 14th in 1978 and 11th in 1979 in total stone production, with an annual tonnage of approximately 37 million short tons valued in excess of $100 million. A total of 103 quarries were operating in 1979; 83 produced crushed stone; 18, dimension stone; and 2, both crushed and dimension stone. Leading stone-producing counties were Erie, Greene, Niagara, and Rockland. Principal producers were Allied Chemical Corp., Atlantic Cement Co., General Crushed Stone Co., and Lone Star Industries, Inc.

Table 7.—New York: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	334	1,752	389	1,665	370	1,813
Concrete aggregate	[2]3,214	[2]18,780	3,791	12,325	3,409	11,774
Bituminous aggregate	6,299	[r]18,625	7,281	22,552	7,572	26,214
Macadam aggregate	753	2,087	656	1,985	625	2,015
Dense-graded roadbase stone	5,588	[r]14,782	7,266	19,624	7,211	23,354
Surface treatment aggregate	1,478	4,385	1,585	4,730	1,519	5,004
Other construction aggregate and roadstone	4,838	[r]12,745	5,626	14,495	5,786	16,906
Riprap and jetty stone	608	1,975	749	2,528	754	2,757
Railroad ballast	318	844	408	1,062	564	1,788
Filter stone	4	16	140	328	81	123
Manufactured fine aggregate (stone sand)	W	W	869	2,242	1,105	3,184
Cement manufacture	5,283	8,131	5,605	9,744	6,204	10,888
Bedding material	16	26	--	--	--	--
Other uses[3]	1,189	4,402	1,385	5,250	1,750	6,513
Total[4]	29,922	88,509	35,748	98,530	36,901	112,362

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1]Includes limestone, granite (1978-79), sandstone, traprock, miscellaneous stone (1977), and slate.

[2]Includes manufactured fine aggregate (stone sand).

[3]Includes stone used for poultry grit and mineral food (1979), terrazzo and exposed aggregate, lime manufacture (1978-79), flux stone, chemical stone, abrasives, asphalt filler (1979), whiting (1977), other filler (1978-79), drain fields, fill, lightweight aggregate, roofing granules (1979), unspecified uses, and uses indicated by symbol W.

[4]Data may not add to totals shown because of independent rounding.

Table 8.—New York: Dimension stone[1] sold or used by producers, by use

Use	1977			1978			1979		
	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)
Rough stone:									
Irregular-shaped stone	902	11	$32	932	12	$36	780	10	$29
Rubble	3,445	40	[r]40	889	10	22	1,778	21	36
Flagging	7,733	92	789	W	W	W	11,218	128	1,106
Dressed stone:									
Cut stone	5,553	67	857	6,069	73	990	5,410	65	835
House stone veneer	699	8	30	W	W	W	795	9	W
Flagging	4,588	52	[r]242	4,675	53	273	5,540	63	323
Flooring slate	949	10	194	839	9	211	669	7	161
Other uses[2]	1,184	15	86	11,245	133	1,064	810	9	136
Total[3]	25,053	295	2,272	24,649	290	2,586	27,000	314	2,626

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1]Includes limestone (1977), granite, sandstone, and slate.

[2]Includes stone used for rough blocks, rough flagging (1978), house stone veneer (1978-79), curbing, standard roofing slate (1979), structural and sanitary, unspecified uses, and uses indicated by symbol W.

[3]Data may not add to totals shown because of independent rounding.

Nearly 92% of the crushed stone consisted of limestone; other types were granite, sandstone, and traprock. Main uses included bituminous aggregate, roadbase, and cement manufacture. Unit value of crushed stone in 1978 was $2.76.

Dimension stone was mainly granite, slate, and sandstone, produced in Albany, Delaware, Essex, Franklin, Orleans, Tompkins, Washington, and Westchester Counties. Main uses included cut stone and rough and dressed flagging. Of the types of dimension stone produced, granite was the most expensive, at nearly $146 per short ton; the least expensive was dimension sandstone, with a unit price of $88.

Sulfur.—Elemental sulfur was recovered at the refinery of Ashland Oil, Inc., in Erie County, through desulfurization during refining. Recovered sulfur was used in chemicals and various synthetic products.

Talc.—Gouverneur Talc Co., Inc., operated three talc mines and two plants in St. Lawrence County near the towns of Edwards and Fowler. Production and value of talc, from 1978 to 1979, increased approximately 3% and 8%, respectively. Crude talc was ground in company-owned mills and used mainly in ceramics and as a mineral filler in paints. Lesser quantities were used as filler in floor tile, rubber, paper, and various other products.

Vermiculite.—Crude vermiculite mined in other States was exfoliated at the Construction Products Div. plant of W. R. Grace & Co., Weedsport, Cayuga County. The expanded vermiculite was used for loosefill insulation, soil conditioning, ultralightweight concrete aggregate, and building plaster aggregate.

Wollastonite.—New York was the only State that produced wollastonite. Interpace Corp. operated two mines near Willsboro, Essex County, and R.T. Vanderbilt Co., Inc., operated the Valentine mine in Lewis County. In late 1979, NYCO, a division of Process Minerals, Inc., purchased Interpace Corp. and continued operation of the two mines. Wollastonite is a calcium silicate found in metamorphic rocks. Major markets for the mineral exist in ceramics, coatings, plastics, refractories, welding rod fluxes, insulating boards, and metal casting plasters. Similar markets have been developed in foreign countries, and several thousand tons per year were exported overseas.

METALS

Aluminum.—Primary aluminum was produced by Aluminum Company of America and Reynolds Metals Co., in St. Lawrence County. Both companies were located there because of an adequate and inexpensive supply of electricity. In 1979, the State Power Authority allowed the James A. Fitzpatrick electric plant to increase rates by nearly 50%. Alcoa, which purchases the bulk of the power from the the Fitzpatrick plant, expects its electric costs to increase 38%. Reynolds Metals also expects increased electric costs.

Ferroalloys.—New York was one of 18 States that produced ferroalloys, used by the steel industry to manufacture stainless, electrical, and carbon steels, and by foundries to manufacture iron castings. In May 1979, Airco, Inc., a wholly owned subsidiary of BOC International Ltd., announced the sale of its ferroalloys business in Niagara Falls to SKW Trostberg A.G., a major European multiproduct manufacturer.

Iron Ore.—Iron ore was produced from NL Industries, Inc.'s open-pit MacIntyre mine in Essex County. Although Jones & Laughlin Steel Corp.'s Benson mine, in St. Lawrence County, permanently closed in 1978, some iron ore was shipped from stock in 1979. Reclamation at J&L's Benson mine is currently underway, involving an open cut measuring 2.5 miles in length to depths of 400 feet, and a 250-acre tailing pond.

Iron and Steel.—Production of pig iron in 1979 totaled 3.4 million short tons valued in excess of $700 million, a decline of 1% in quantity but an increase of nearly 2% in value compared with the 1978 figures. Reduced production is expected to continue, owing to foreign imports and reduced demand within the country. At the beginning of 1979, five furnaces were operating and four were idle. Types of pig iron produced were basic, low-phosphorus, and malleable.

Although production of pig iron has been declining, companies continue to modernize. Roblin Industries, Inc., Buffalo, plans to increase its steel-producing capacity to 180,000 tons and its steel-finishing capacity to 200,000 tons annually by 1980. Plans include addition of a third electric arc furnace and a forge rolling machine.

The recently formed Tonawanda Coke Corp. regained full production following a fire at the facility, formerly owned by Semet-Solvay.

Auburn Steel Co. of Auburn, owned by A. C. Sango of Tokyo and Kyoci Steel of Osaka, operated around the clock, producing steel bars used in the industrial market. Production in 1978 totaled more than 150,000 tons, with an expected growth rate of 15% annually.

Lead.—Lead was recovered as a byproduct from zinc ore that was produced and processed from St. Joe Minerals Corp.'s Balmat and Edwards mines in St. Lawrence County. Production of lead in 1979 totaled 458 metric tons valued at $532,000, compared with 990 metric tons valued at $735,000 in 1978. Reduced lead production was related to a lower zinc output in 1979.

In April 1979, Atlas Steel V-Process Corp. obtained loans totaling $750,000 for the purchase of new equipment to manufacture castings used as a new vacuum molding process. The castings will be of lead, in order to improve quality. The plant was formerly owned by Atlas Steel Castings Corp., Buffalo.

Silver.—In 1978, St. Joe Minerals Corp. recovered 21,000 troy ounces of silver valued at $113,000 from lead concentrate (Balmat and Edwards mines). Because of a drop in zinc production in 1979, silver output decreased to nearly 11,000 troy ounces valued at $117,000.

Table 9.—New York: Mine production (recoverable) of silver, lead, and zinc

		1977	1978	1979
Mines producing: Lode		3	3	3
Material sold or treated: Zinc ore	thousand metric tons	1,084	392	144
Production:				
Quantity:				
Silver	troy ounces	56,353	20,911	10,538
Lead	metric tons	2,520	990	458
Zinc	do	64,264	26,463	12,133
Value:				
Silver	thousands	$260	$113	$117
Lead	do	$1,706	$735	$532
Zinc	do	$48,737	$18,086	$9,977
Total	do	$50,703	$18,934	$10,626

Titanium Concentrate (Ilmenite).—Ilmenite concentrate was produced by NL Industries, Inc., Essex County, as a coproduct from the Tahawus titaniferous magnetite deposit. In 1979, production and value increased 14% and 28%, respectively, compared with 1978 levels. Titanium was used mainly in the manufacture of titanium dioxide pigments for the paint, varnish, and lacquer industry.

Zinc.—Production and value in 1979 declined nearly 50% compared with those of 1978, because of a 13-month strike that ended in July 1979. The entire State production came from the Balmat and Edwards mines, operated by St. Joe Minerals Corp., St. Lawrence County. As a result of foreign competition and the lack of demand for zinc, approximately 220 of the 655 workers were permanently idled.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives:			
The Carborundum Co	Box 423 Niagara Falls, NY 14302	Plant	Niagara.
General Abrasives Div. of Dresser Industries.	2000 College Ave. Niagara Falls, NY 14305	do	Do.
Pellets, Inc	531 South Niagara St. Tonawanda, NY 14150	do	Do.
Aluminum smelters:			
Aluminum Company of America	1210 Alcoa Bldg. Pittsburgh, PA 15222	do	St. Lawrence.
Reynolds Metals Co	Box 27003-2A Richmond, VA 23215	do	Do.
Cement:			
Alpha Portland Cement Co.[1]	15 South 3d St. Easton, PA 18043	do	Greene.
Atlantic Cement Co., a subsidiary of Newmont Mining Corp.	Box 30 Stamford, CT 06904	do	Albany.
The Flintkote Co.[2]	400 Westchester Ave. White Plains, NY 10604	do	Warren.
Lehigh Portland Cement Co.[2]	718 Hamilton St. Allentown, PA 18105	do	Greene.
Marquette Cement Manufacturing Co.[1] [2]	20 North Wacker Dr. Chicago, IL 60606	do	Do.
Clays:			
Nassau Brick Co., Inc	635 Round Swamp Rd. Long Island, NY 11804	Pits	Nassau.
Norlite Corp	628 South Saratoga St. Cohoes, NY 12047	do	Albany.
Emery:			
De Luca Emery Mine, Inc	926 Constant Ave. Peekskill, NY 10566	Pit	Westchester.
Garnet:			
Barton Mines Corp	North Creek, NY 12853	Pit	Warren.
Gypsum, calcined:			
Georgia-Pacific Corp	Box 311 Portland, OR 97207	Underground mine and plant.	Erie and Westchester.
National Gypsum Co.[3]	325 Delaware Ave. Buffalo, NY 14202	Plant	Bronx.
United States Gypsum Co.[3]	101 South Wacker Dr. Chicago, IL 60606	Underground mine and plant.	Genesee, Richmond, Rockland.
Iron ore:			
Jones & Laughlin Steel Corp	Star Lake, NY 13690	Pit	St. Lawrence.
NL Industries, Inc.[4]	Tahawus, NY 12879	Pit	Essex.
Lime:			
Allied Chemical Corp.[1] [5]	Box 70 Morristown, NJ 07960	Plant	Onondaga.
Bethlehem Steel Corp	701 East 3d St. Bethlehem, PA 18016	do	Erie.
Peat:			
Anderson Peat Co., Inc	Pleasant Hill Rd. Wingdale, NY 12594	Bog	Dutchess.
Sterling Forest Peat Co., Inc	Box 608 Tuxedo, NY 10987	Bog	Orange.
Salt:			
Cargill, Inc	1620 Northstar Ctr. Minneapolis, MN 55402	Underground mine.	Tompkins.
International Salt Co	Clarks Summit, PA 18411	do	Livingston.
Morton Salt Co	110 North Wacker Dr. Chicago, IL 60606	Well	Wyoming.
Sand and gravel:			
Colonial Sand & Stone Co., Inc.[1] [2] [6]	1740 Broadway New York, NY 10019	Pit	Dutchess and Nassau.
General Crushed Stone Co., a division of Koppers Co.	712 Drake Bldg. Easton, PA 18042	Pit	Cattaraugus and Chemung.
Keyway Mason Supply Corp	25 Montclair Ave. St. James, NY 11780	Pit	Suffolk.
Roanoke Marbro Sand & Gravel Corp	Box 172 Riverhead, NY 11901	Pit	Do.
Slag:			
Buffalo Slag Co	111 Great Arrow Ave. Buffalo, NY 14216	Plants	Allegany, Cattaraugus, Steuben.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone:			
Callanan Road Improvement Co., a division of Penn Dixie Industries.	South Bethlehem, NY 12161	Quarry	Albany and Ulster.
Dolomite Products Co.[7]	1150 Penfield Rd. Rochester, NY 14625	do	Monroe.
General Crushed Stone Co., a division of Koppers Co.	712 Drake Bldg. Easton, PA 18042	do	Genesee, Herkimer, Jefferson, Livingston, Onondaga, Ontario, Wayne.
Lone Star Industries, Inc	One Greenwich Plaza Greenwich, CT 06830	Pits	Ulster.
Sulfur, elemental:			
Ashland Oil & Refining Co.[1]	Tonawanda, NY 14150	Refinery	Erie.
Talc:			
Gouverneur Talc Co., Inc	Gouverneur, NY 13642	Underground mine.	St. Lawrence.
Wollastonite:			
Interpace Corp.[8]	Willsboro, NY 12996	do	Essex.
Zinc:			
St. Joe Minerals Corp.[9]	250 Park Ave. New York, NY 10017	Mine	St. Lawrence.

[1] Also stone.
[2] Also clays.
[3] Also expanded perlite.
[4] Also ilmenite.
[5] Also salt.
[6] Also cement.
[7] Also sand and gravel.
[8] Also garnet.
[9] Also silver and lead.

The Mineral Industry of North Carolina

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Division of Earth Resources, North Carolina Department of Natural and Economic Resources, for collecting information on all nonfuel minerals.

By Eugene C. Baker[1] and Eldon P. Allen[2]

The value of North Carolina's nonfuel mineral production in 1978 and 1979 added $295 million and $342 million, respectively, to the State's economy. Stone was the leading mineral commodity in terms of output and value. The five leading mineral commodities consisting of stone, phosphate rock, sand and gravel, cement and lithium minerals accounted for almost 90% of the State's total mineral value in 1978 and 1979.

The combined output of stone, sand and gravel, and cement in 1978 was 16% greater than that of 1977, owing primarily to accelerated building programs in the industrial, commercial, and residential construction industries. In 1979, the combined production of these commodities was virtually unchanged from that of 1978.

In 1978 and 1979, North Carolina was the leading State in the Nation in the production of feldspar, lithium minerals, scrap mica, and pyrophyllite. It ranked second in the output of common clay, crushed granite, and olivine and third in the output of crushed marble and phosphate rock.

Table 1.—Nonfuel mineral production in North Carolina[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2] thousand short tons	3,022	$4,990	3,542	$9,067	3,308	$8,385
Feldspar short tons	509,976	11,410	509,291	11,178	523,663	14,531
Gem stones	NA	75	NA	50	NA	50
Mica, scrap thousand short tons	91	[r]5,071	97	5,729	91	5,892
Sand and gravel do.	9,690	21,269	11,446	28,080	11,203	29,733
Stone:						
Crushed do.	32,810	87,254	37,687	108,867	39,864	125,319
Dimension do.	40	3,041	40	3,050	49	3,932
Talc and pyrophyllite do.	W	W	W	W	130	692
Combined value of asbestos, cement, clays (kaolin), lithium compounds, mica (sheet, 1977-78), olivine, phosphate rock, and values indicated by symbol W	XX	99,265	XX	128,557	XX	153,752
Total	XX	[r]232,375	XX	294,578	XX	342,286

[r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes kaolin; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in North Carolina, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Alamance	W	W	Stone, clays.
Anson	$5,267	W	Sand and gravel, stone.
Ashe	W	W	Stone.
Avery	W	W	Mica, olivine, stone, clays, sand and gravel.
Beaufort	W	W	Phosphate rock, sand and gravel.
Bertie	W	W	Sand and gravel.
Bladen	23	W	Do.
Brunswick	53	$11	Do.
Buncombe	W	W	Stone, sand and gravel, clays.
Burke	W	W	Stone, sand and gravel.
Cabarrus	1,135	W	Stone, sand and gravel, clays.
Caldwell	W	W	Stone, sand and gravel.
Camden	--	W	Sand and gravel.
Caswell	W	W	Stone.
Catawba	W	W	Stone, sand and gravel.
Chatham	970	1,827	Clays, stone.
Cherokee	W	W	Stone, talc.
Chowan	W	10	Sand and gravel.
Cleveland	12,481	15,001	Lithium minerals, mica, feldspar, stone, sand and gravel, clays
Craven	W	W	Stone, sand and gravel.
Cumberland	698	697	Sand and gravel.
Currituck	10	W	Do.
Dare	--	W	Clays.
Davidson	W	W	Stone, clays.
Davie	W	W	Stone, sand and gravel.
Duplin	W	W	Do.
Durham	W	W	Stone, clays.
Edgecombe	W	W	Stone, sand and gravel.
Forsyth	W	W	Do.
Franklin	131	W	Sand and gravel.
Gaston	12,438	W	Lithium minerals, feldspar, stone, mica, sand and gravel.
Granville	W	W	Talc.
Greene	W	W	Sand and gravel.
Guilford	5,399	W	Stone, sand and gravel, clays.
Halifax	W	W	Clays.
Harnett	W	W	Sand and gravel, clays.
Haywood	W	918	Stone.
Henderson	W	W	Stone, clays.
Hertford	W	W	Sand and gravel.
Hyde	W	22	Do.
Iredell	W	W	Stone, clays, sand and gravel.
Jackson	W	W	Stone, sand and gravel.
Johnston	W	W	Do.
Jones	75	131	Stone.
Lee	W	W	Stone, clays, sand and gravel.
Lenoir	W	W	Sand and gravel.
McDowell	582	745	Do.
Macon	W	W	Stone, sand and gravel.
Martin	W	17	Sand and gravel.
Mecklenburg	W	W	Stone.
Mitchell	9,661	W	Feldspar, stone, mica, clays, sand and gravel.
Montgomery	W	W	Sand and gravel, stone, clays.
Moore	W	W	Talc, sand and gravel, clays.
New Hanover	23,476	30,418	Cement, stone, clays, sand and gravel.
Northampton	W	W	Sand and gravel.
Onslow	W	W	Stone, sand and gravel.
Orange	1,581	1,594	Stone, talc, sand and gravel, mica.
Pasquotank	W	W	Sand and gravel.
Pender	W	161	Stone.
Pitt	W	W	Stone, sand and gravel.
Polk	87	--	
Randolph	W	W	Stone.
Richmond	2,353	4,443	Sand and gravel, stone.
Rockingham	W	W	Stone, clays, sand and gravel.
Rowan	W	W	Do.
Rutherford	664	W	Stone.
Sampson	299	W	Clays, sand and gravel.
Scotland	6	6	Sand and gravel.
Stanly	754	W	Clays, stone.
Stokes	W	W	Stone, sand and gravel, clays.
Surry	3,797	W	Stone, sand and gravel.
Swain	W	W	Stone.
Transylvania	W	W	Stone, sand and gravel.
Tyrrell	W	24	Sand and gravel.
Union	W	W	Stone, clays.
Vance	W	W	Stone.
Wake	W	W	Stone, sand and gravel, clays.
Washington	W	29	Sand and gravel.
Watauga	641	895	Stone.
Wayne	187	235	Sand and gravel.
Wilkes	W	W	Stone, sand and gravel.
Wilson	W	W	Stone.
Yadkin	W	W	Sand and gravel.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in North Carolina, by county[1] —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Yancey	W	W	Olivine, mica, sand and gravel, asbestos.
Undistributed[2]	$149,608	$237,393	
Total[3]	[r]232,375	294,578	

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] The following counties are not listed because no production was reported: Alexander, Allehgany, Carteret, Clay, Columbus, Gates, Graham, Hoke, Lincoln, Madison, Nash, Pamlico, Perquimans, Person, Robeson, and Warren.

[2] Includes gem stones and sand and gravel that cannot be assigned to specific counties and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of North Carolina business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	2,615.0	2,676.0	2,692.0	+6.0
Unemployment do	155.0	116.0	129.0	+11.2
Employment (nonagricultural):				
Mining do	4.7	4.8	5.0	+4.2
Manufacturing do	780.9	807.2	824.2	+2.1
Contract construction do	106.8	118.1	126.0	+6.7
Transportation and public utilities do	103.4	109.5	115.3	+5.3
Wholesale and retail trade do	421.9	446.6	482.9	+8.1
Finance, insurance, real estate do	84.5	88.7	93.6	+5.5
Services do	300.6	316.1	344.4	+5.8
Government do	367.6	386.4	395.5	+2.4
Total nonagricultural employment do	2,170.4	2,277.4	2,376.9	+4.4
Personal income:				
Total millions	$32,667	$37,029	$41,257	+11.4
Per capita	$5,923	$6,640	$7,359	+10.5
Construction activity:				
Number of private and public residential units authorized	33,004	[1]42,812	39,205	-8.4
Value of nonresidential construction millions	$392.9	$539.6	$559.0	+3.6
Value of State road contract awards do	$250.0	$179.0	$238.0	+33.0
Shipments of portland and masonry cement to and within the State thousand short tons	1,787	2,039	1,883	-7.6
Nonfuel mineral production value:				
Total crude mineral value millions	[r]$232.4	$294.6	$342.3	+16.2
Value per capita, resident population	$42	$53	$61	+15.1
Value per square mile	[r]$4,419	[r]$5,602	$6,509	+16.2

[p] Preliminary. [r] Revised.

[1] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

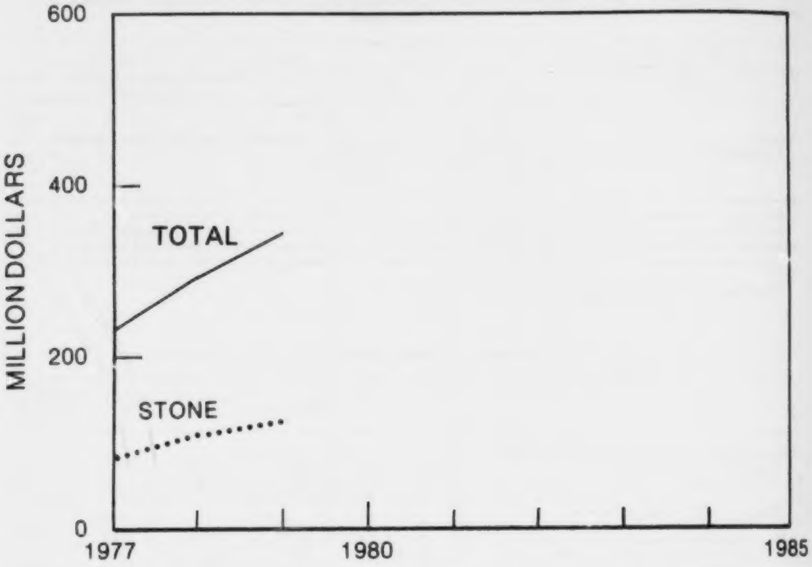

Figure 1.—Value of stone and total value of nonfuel mineral production in North Carolina.

Trends and Developments.—Industrial growth in new and expanded industries in 1978 and 1979 established new records highs, with capital investments of $2.1 billion and $2.4 billion, respectively. These figures represented an increase of more than 40% over 2 years. Total capital growth (domestic and foreign) contributed to the creation of more than 29,000 new jobs in the State in 1978 and 37,000 new jobs in 1979. From 1977 to 1979, employment increased by 39%. Although only about 5,000 of the State's 2.4 million industrial workers were employed directly in mineral extraction in 1978 and 1979, approximately 384,000 workers, or 16% of the work force, were employed in processing mineral raw materials or in industries that were heavily dependent upon mineral-derived products.

In 1979, foreign investments in North Carolina continued the dramatic increase begun in 1978. During these 2 years, the total foreign investment of $395 million exceeded that of the preceding 13 years. The total accumulative foreign investment in North Carolina was estimated at $1.5 billion, and the State had more foreign firms operating plants in it than did any other State in the Southeast. Almost 6,000 jobs were created as a result of foreign investment in 1978 and 1979.

A Belgian firm, Metallurgie Hoboken Overpelt S.A. of Antwerp, began construction of a $20 million plant at Laurinburg to produce extra-fine cobalt powder for the U.S. market. African Metals Corp., New York, was chosen to be the exclusive supplier of cobalt material to the firm. The processing facility was scheduled for completion in 1980, its annual production of cobalt powder was projected at produce approximately 1 million pounds. The operating company was named Carolmet, Inc.

Triangle Brick Co., in Durham, was purchased by the Roeben Co., Inc., a West German manufacturer. Plans were for triangle to continue to produce brick and floor tile under its present management and name. Roeben paid $10.9 million to purchase the plant.

Several domestically owned mineral-producing companies initiated or completed construction of new plants and/or expansion of existing facilities. Florida Steel Co. installed a third electric arc furnace and other equipment at its Charlotte mill in 1979. Installation of the equipment was expected to increase the mill's billet capacity to approximately 160,000 net tons annually, compared with a pre-installation capacity of 100,000 tons. The total cost of the

The Public Library, Newark, N.J.

new installation was estimated at $10 million.

Reynolds Metal Co. opened a new aluminum-recycling plant in Raleigh in 1978, with a capacity of 86,000 pounds daily. The public may sell aluminum cans either directly at the new plant or to any one of its 51 collection stations located throughout the State. The product is shipped to Williamsburg, Va., for further processing and then to Richmond, Va., where it is smelted into ingots and rolled and stamped for use in a cannery.

Aluminum Co. of America (Alcoa) began construction in 1979 on a $10 million project to install two continuous casting machines at its Badin, N.C., works to meet increased demand for flat-rolled products. The casting machines were being designed to convert molten metal produced at the Badin smelting facility into coiled stock for shipment to other Alcoa locations, where plans were for the stock to be fabricated into light-gauge sheet and foil. The project was scheduled for completion in 1980.

National Aluminum Corp., a subsidiary of National Steel Corp., Pittsburgh, was doubling the capacity of its aluminum-foil plant at Salisbury. The expansion was projected to cost $20 million and was being planned to include new melting and casting facilities, two rolling mills, and supporting equipment.

Libbey-Owens-Ford commenced construction in 1979 of a second float-glass facility at its Laurinburg plant. The new addition was estimated to cost $60 million, and was expected to increase the production of float glass by 25% when completed in 1980.

Texasgulf Chemicals started construction on a $130 million expansion program at its Lee Creek phosphate operation in 1979. Upon its completion in 1982, the annual output of phosphate fertilizer was expected to increase from the pre-expansion level of 680,000 tons to slightly more than 1 million tons. Major elements planned for the expansion included a 3,100-ton-per-day sulfuric acid plant and additional diammonium phosphate capacity.

Smith-Corona-Marchand Corp. started construction of a $10 million facility at Durham in October 1979 for the production of copper and tool steel powders, which are used in the manufacture of light bulbs, welding electrodes, and dies, and in the automotive and appliance industries. About 75 workers were expected to be employed at the facility. Startup was scheduled for late 1980.

Legislation and Government Programs.—During 1978, the Geological Survey Section of the Division of Land Resources, North Carolina Department of Natural Resources and Community Development, published a report on mineral collecting sites in the State.[3] The publication was prepared to assist those interested in minerals and gems. The Survey also published an index of geological and geophysical investigations that were conducted in the State in 1978.[4]

A report on the diabase dikes of the eastern Piedmont of North Carolina was prepared.[5] The report includes brief text and a map showing detailed locations of diabase occurrences.

A revised report on gold in North Carolina was completed.[6] Its text is designed for the layman, and maps, photographs, and general information on gold in the State is also included.

In 1979, a report was published on the geology and mineral resources of Wake County.[7] It contains geologic and mineral resource descriptions, along with 23 illustrations that include a colored geologic map at a scale of 1:100,000.

The Land Quality Section, Division of Land Resources, Department of Natural Resources and Community Development, issued 33 mining permits during 1978. The number of acres mined totaled 700, and the total number of acres disturbed by mining was 1,000. During the year, 625 acres were reclaimed. The uses of the land after reclamation were as follows: Pasture 35%, forest 30%, lakes 28%, wildlife 5%, and commercial 2%. In 1979, 29 mining permits were issued. The number of acres mined totaled 788, and the total number of acres disturbed was 1,301. Land reclaimed after mining totaled 632 acres in 1979.

The North Carolina Coastal Management Program was approved by the U.S. Department of Commerce on September 1, 1978. It included a description of the State's coastal issues, policies, and authorities, ongoing processes of coastal management, and coastal area boundaries. Federal approval of the program made the State eligible to receive an initial $1.18 million for the program's implementation.

During 1978 and 1979, the Minerals Research Laboratory of North Carolina State University at Asheville completed several projects that were of interest to the mineral industry. These included flotation and evaluation of feldspar-quartz, measuring and improving the efficiency of a spodumene flotation plant, beneficiation and evaluation of quarry wastes, upgrading coarse sand by washing and scrubbing, evaluation of feldspar flotation reagents, flocculation and dispersion of wet-ground mica, recovery of heavy minerals, beneficiation of byproduct glass sand, flotation of flint-grade glass sand, beneficiation of Yancey County olivine, nonfluoride flotation of byproduct feldspar, and recovery of heavy metal concentrates by tabling. Information on many of these projects is available from the Minerals Research Laboratory.[8]

The 1979 General Assembly of North Carolina ratified House Bill 791, amending section I-42.5 of the Mining Act. The bill requiries that within 2 years from November 1, 1979, all oil, gas, or mineral interests in lands severed or separated from fee-simple ownership shall be assessed for ad valorem taxes as real property. Also passed was House Bill 74-64, which provides for a penalty of $5,000 against any person who fails to secure a valid operating permit prior to engaging in mining.

The Federal Bureau of Mines completed studies of the mineral potential of the Craggy Mountain Wilderness Study Area and the Craggy Mountain in Buncombe County, N.C., as part of the Roadless Area Review and Evaluation program. Results of the studies are available as U.S. Geological Survey Reports, Also being prepared were reports for the Linville Gorge Wilderness Area, Burke and McDowell Counties, and the Shining Rock Wilderness Area, Haywood County.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abestos.—Powhatan Mining Co. produced asbestos from its Hippy Mine in Yancey County. The mine's output and value in 1978 approximately doubled as Powhatan built a stockpile because its mining lease was not renewed for 1979.

Cement.—Ideal Basic Industries, Inc., the only cement operation in the State, manufactured both portland and masonry cement at its plant near Castle Hayne, New Hanover County. Increased sales of portland and masonry cement in 1978 reflected greater demand for private and public buildings, as well as greater demand by heavy construction contractors. There was an increase in the unit value of both products as a result of higher fuel costs for plant energy. In 1979, portland cement sales were slightly off, but masonry cement showed a modest increase over sales in 1978. Sixty percent of the State's cement shipments moved by rail; the remainder was transported by truck bulkloads. Nearly all cement sales were transacted within the State, although some cement was shipped to South Carolina.

Clays.—In 1979, North Carolina was the fourth largest producer of clays in the Nation. Common clay and shale and kaolin were produced by 25 companies operating 43 pits in 23 counties. The leading producers, in order of output, were Sanford Brick Corp. (three pits), Boren Clay Products Co. (five pits), Solite Corp. (two pits), and Pine Hall Brick & Pipe Co. (six pits). These four producers accounted for 49% of the State's clay output. The State's output of common clay and shale, which is used primarily for the manufacture of brick, sewer pipe, concrete block, and cement, decreased 6% in 1979, compared with that of 1978. Kaolin was produced by Harris Mining Co., Avery County, and Kings Mountain Silica Co., Cleveland County. Kaolin was used in the manufacture of specialty china, refractories, and face brick.

North Carolina continued to hold its position as the Nation's leading brick producer, a status it first attained in 1962. The State produced 1.2 billion brick valued at over $100 million, accounting for 14% of all U.S. brick production in 1978. In 1979, the State's output was 1.04 billion brick. Because of the almost total automation of brick plants in North Carolina, increased production has been achieved without increases in the number of plant personnel. The skyrocketing cost of fuel has significantly contributed to the price of brick, which in 1979 was approaching $100 per thousand.

Table 4.—North Carolina: Common clay and shale sold or used by producers, by county

County	1977			1978			1979		
	Number of mines	Quantity (short tons)	Value	Number of mines	Quantity (short tons)	Value	Number of mines	Quantity (short tons)	Value
Alamance	2	77,467	$131,694	2	90,215	157,876	2	85,092	156,399
Buncombe	1	W	61,200	1	W	94,500	1	W	W
Cabarrus and Durham	4	245,439	499,502	3	257,670	630,230	3	225,920	549,306
Chatham	4	479,548	939,849	4	569,393	1,826,325	4	584,501	2,183,282
Davidson	1	90,000	126,000	1	126,000	198,000	1	125,000	216,563
Guilford	2	74,482	193,731	2	W	W	2	W	W
Harnett	1	W	W	1	W	W	1	W	W
Henderson	1	W	91,800	1	W	W	1	W	W
Iredell	1	W	W	1	W	W	1	W	W
Lee	3	514,000	395,600	3	599,009	2,246,912	3	522,301	843,622
Montgomery and New Hanover	4	173,493	383,711	4	184,849	481,178	4	173,890	514,226
Rockingham	5	438,304	455,042	5	542.528	726,581	5	468,247	672,984
Rowan	4	166,285	280,375	4	176,978	373,291	4	186,296	422,584
Sampson	1	56,125	189,141	1	W	W	1	W	W
Stanly	3	302,700	704,350	3	364,610	1,001,688	3	376,290	1,480,807
Stokes	1	21,207	16,966	1	17,255	18,981	1	20,620	23,713
Union	1	173,585	303,774	1	W	W	1	W	W
Undistributed[1]	4	209,420	216,850	5	619,966	1,311,565	5	540,188	1,321,665
Total	43	3,022,055	4,989,585	43	3,542,473	9,067,127	43	3,308,345	8,385,151

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes Halifax, Moore, and Wake Counties and data indicated by symbol W.

Feldspar.—North Carolina was the Nation's leading producer of feldspar in 1978 and 1979. Production for the period remained generally unchanged. Six companies operated eight mines in Cleveland, Gaston, and Mitchell Counties in 1978. Leading producing companies, in descending order of output, were The Feldspar Corp., Lawson-United Feldspar and Mineral Co., and International Minerals & Chemical Corp., all in Mitchell Cou[illegible]. The largest amount of feldspar marketed was in the form of flotation concentrates; lesser quantities were marketed in the form of feldspar-silica mixtures.

Gem Stones.—The value of gem stones collected by rock hounds in North Carolina in 1979 was estimated at $50,000. Most of the collecting activity was centered around Franklin in Macon County, Spruce Pine in Mitchell County, and near Hiddenite in Alexander County. Garnet, rubies, and sapphirres are found in the Franklin area; emerald and aquamarine are found in the Spruce Pine area; and hiddenite and emerald are found in the Hiddenite area. Other gems of lesser value are also found in these areas.

Graphite.—Synthetic graphite products were manufactured by Great Lakes Carbon Corp. at its plant near Morganton and included anodes, electrodes, crucibles and vessels, and graphite specialties. Raw materials from which the graphite was made consisted mainly of coal-tar pitch obtained from out-of-State sources. Production in 1978 and 1979 showed a modest gain.

Gypsum.—Texasgulf, Inc., marketed byproduct gypsum recovered at its phosphoric acid and fertilizer processing operation at Lee Creek, near Aurora. There was a slight decrease in production during 1978 and 1979, compared with that of 1977. The principal use of the State's gypsum was as a soil additive.

Iodine.—Mallinkrodt Chemical Works, near Raleigh, Wake County, consumed crude iodine in the manufacture of several products. The company operated three plants in the Raleigh area and produced high-purity specialty chemicals, plastics, and iodinated contrast media for use in X-ray applications.

Lithium Minerals.—North Carolina was the leading State in the production of lithium minerals in 1978 and 1979. Foote Mineral Co. operated a mine and plant near Kings Mountain, Cleveland County; and Lithium Corp. of America, Inc., operated mines and a processing plant in Gastonia, Gaston County. There was a substantial increase in the production and value of lithium compounds in 1978 and a modest increase in 1979. The increases in output resulted from strong demand by the aluminum and synthetic rubber industries and from demand that stemmed from the manufacture of ceramics and multipurpose greases. Lithium metal and salts consumption was growing most rapidly in the manufacture of minibatteries utilized in electronic and communication equipment, life support devices, and industrial instruments.

In late 1979, Foote Mineral Co. added

processing equipment at its Kings Mountain operation that increased its capacity for the production of lithium carbonate from 12 million pounds per year to 14 million pounds per year. Lithium Corp. had an estimated capacity of 28 million pounds per year at its Bessemer City location. The company planned to increase its capacity at that location to 36 million pounds per year by 1980 and to 45 million pounds per year by 1981. Both companies were also engaged in the production of lithium compounds in foreign countries.

Mica.—North Carolina continued to lead the Nation in the production of crude mica in 1978 and 1979, with annual production totals of 97,000 tons and 91,000 tons, respectively. The State accounted for about 52% of the Nation's production. Only a minor amount of sheet mica was produced; its output was estimated at less than 500 pounds in 1979.

Crude mica was produced by 10 companies from 13 mines in 7 counties. Principal producers, listed in descending order of output, were Harris Mining Co. in Avery County; Kings Mountain Mica Co., Inc., with two operations in Cleveland County; and The Feldspar Corp., with three operations in Mitchell County.

Table 5.—North Carolina: Ground mica sold or used by producers, by use

Use	1977		1978		1979	
	Quantity (short tons)	Value	Quantity (short tons)	Value	Quantity (short tons)	Value
Roofing	3,216	$199,950	W	W	W	W
Paint	7,929	1,623,553	7,572	$1,634,013	6,776	$1,595,259
Rubber	5,121	1,197,323	4,116	1,043,611	4,197	1,177,459
Joint cement	25,460	2,423,918	29,065	2,719,820	39,236	4,470,083
Other uses[1]	[r]29,046	[r]3,062,262	36,265	4,171,054	31,213	4,333,441
Total	70,772	8,516,006	77,018	9,568,498	81,422	11,576,242

[r] Revised. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Includes plastics, textile coatings, wallpaper, well drilling, other miscellaneous uses, and uses indicated by symbol W.

Ground mica was produced by 10 companies operating 12 plants. Seven companies ground a dry product for market, and three produced wet-ground mica. One company produced both wet- and dry-ground mica. Total ground mica accounted for more than 85% of crude mica production in 1979. Principal uses for both types of mica were in joint cement, well drilling mud, paint, rubber products, and roofing material. Both the production and value of ground mica increased substantially in 1978.

Olivine.—North Carolina led the Nation in olivine production in 1978 and 1979. Output remained unchanged in 1978, but increased 39% in 1979 as a result of increased demand by foundries for use as molding sand. Olivine was also used as a flux to control slag formation in steelmaking, and as a blasting sand in lieu of silica sand, which is suspected of promoting silicosis. International Minerals & Chemical Corp. was the major producer, with plants in Burnsville, Yancey County, and in Addie, Jackson County.

The Mineral Research Laboratory of North Carolina State University at Asheville received funds to develop technology to produce heat-storage bricks made from olivine. Such bricks could be used in utility and homeowners' heating systems as a means of lowering heating costs and conserving fuel. North Carolina, with olivine reserves estimated at 1.2 billion tons, has ample material for the many potential uses of this mineral, which are currently under investigation.

Perlite.—Carolina Perlite Co., Inc., near Gold Hill, Rowan County, expanded perlite obtained from out-of-State sources. Nearly all of the output was used in concrete and plaster aggregate. Product sales experienced a substantial gain in 1978 over those of 1977 that was prompted by increased building activity in the Southeastern States. In 1979, sales showed a modest increase.

Phosphate Rock.—Texasgulf, Inc., was the only producer of phosphate rock in North Carolina in 1978 and 1979. The total output of marketable product rose 36% in 1978 and 9% in 1979. The unit value was essentially stable during the biennium. Stepped-up production and sales of North Carolina phosphate rock were the result of growing domestic and foreign demand for fertilizer. Domestic production increased by 9% in 1979, and shipments to International trade increased by 600%.

Pyrophyllite and Talc.—North Carolina was the only pyrophyllite producer in the Nation in 1978 and 1979. Pyrophyllite was used mainly for the manufacture of insecticides, refractories, and ceramics. Pyrophyllite output increased 21% during the biennium, and the increase was attributed to the larger quantities of pyrophyllite that were being used in the manufacture of liquid insecticides as a result of U.S. Environmental Protection Agency (EPA) regulations. In prior years, lesser quantities of pyrophyllite were required for dry insecticides that were equally effective.

Pyrophyllite was produced by four companies at seven mines. These companies, listed in descending order of output, were Piedmont Minerals Co., Inc., in Orange County (one mine); Standard Minerals Co., Inc., in Moore County (two mines); Glendon Pyrophllite, Inc., Moore County (two mines); and Tredmont Inc., Granville County (one mine).

Hitchcock Corp., near Murphy, Cherokee County, was the only producer of talc in the State. Talc was marketed for use in cosmetics and paper manufacture.

Sand and Gravel.—In terms of tonnage and value, sand and gravel was the second-ranking mineral produced in the State in 1978 and 1979. Increased sand and gravel output in 1978 resulted from a greater demand for ready-mix concrete for use in construction.

In 1979, residential and industrial construction slackened, compared with that of 1978. Consequently, the output of construction sand and gravel decreased by about 8%, but its value remained virtually the same. Sand and gravel was produced by 91 companies at 151 operations in 65 counties in 1979. Leading counties, in descending order of output, were Anson, Harnett, Richmond, Buncombe, and Montgomery. These counties accounted for 46% of the State's total output of sand and gravel. The North Carolina State Highway Commission was a large, noncommercial producer of sand and gravel. Principal uses of sand and gravel were in asphaltic concrete, as road base material, and in concrete aggregate.

Table 6.—North Carolina: Construction sand and gravel sold or used, by major use category

	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,885	$8,368	$2.15	5,497	$11,689	$2.13	4,799	$11,589	$2.41
Plaster and gunite sand	NA	NA	NA	W	W	W	128	306	2.40
Concrete products	245	581	2.37	289	648	2.24	548	1,332	2.43
Asphaltic concrete	1,945	3,747	1.93	2,115	4,964	2.35	1,628	3,485	2.14
Roadbase and coverings	1,610	3,138	1.95	1,775	3,762	2.12	1,377	3,220	2.34
Fill	850	981	1.15	639	836	1.31	990	1,216	1.23
Snow and ice control	NA	NA	NA	W	W	W	W	W	W
Railroad ballast	--	--	--	1	5	4.00	1	5	4.00
Other uses	299	451	1.51	113	295	2.60	161	466	2.89
Total[1] or average	8,833	17,267	1.95	10,454	22,246	2.13	9,634	21,618	2.24

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses".

[1] Data may not add to totals shown because of independent rounding.

Table 7.—North Carolina: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	5,326	$8,750	$1.64	6,776	$12,889	$1.83	6,881	$13,443	$1.95
Gravel	3,508	8,517	2.43	3,677	9,857	2.68	2,753	8,175	2.97
Total[1] or average	8,833	17,267	1.95	10,454	22,246	2.13	9,634	21,618	2.24
Industrial:									
Sand	328	1,171	3.58	W	W	W	W	W	W
Gravel	529	2,831	5.35	W	W	W	W	W	W
Total[1] or average	857	4,003	4.67	992	5,834	5.88	1,569	8,115	5.17
Grand total[1] or average	9,690	21,269	2.19	11,446	28,080	2.45	11,203	29,733	2.65

W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Industrial sand was produced at eight operations in six counties. During 1978 and 1979, output increased by 83%. This increase was attributed mainly to the demand for silica sand used to manufacture glass containers and flat glass. In 1979, 52% of the State's industrial sand output was consumed in the manufacture of these two products.

In 1978, Kerr Glass Co., at Wilson, installed four high-capacity glass-container manufacturing machines and added one additional machine in 1979. These installations doubled the company's maufacturing capacity. Ball Glass Co., Asheville, added to its furnace capacity in order to increase the manufacture of containers and specialty glass products. Leading producers of industrial sand were Carolina Silica, Inc., Richmond County; B.V. Hedrick Gravel and Sand Co., Anson County; and Becker Sand & Gravel Co., Harnett County.

Stone.—Stone was the leading mineral commodity produced in the State during 1978 and 1979. Output of crushed stone increased significantly in 1978, as a result of road and building programs. About 80% of the crushed stone produced was used as road base, aggregate in asphalt road mixes, and in building concrete. In 1979, crushed stone production was not as pronounced, since highway work was limited to maintenance and there was far less activity in building construction. Crushed stone was produced by 35 companies at 85 quarries in 1978 and by 37 companies at 87 quarries in 1979. Leading producers for both years were Martin Marietta Corp., Vulcan Materials Co., and Nello L. Teer Co. The State ranked second in the Nation in crushed granite output.

Dimension stone output was stable in 1978, but increased sharply in 1979. The dramatic increase was attributed to out-of-State demand for facing and monumental marble used in building construction. Dimension stone was produced by 8 companies at 17 quarries.

Table 8.—North Carolina: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	W	W	22	83	W	W
Agricultural marl and other soil conditioners	W	W	243	864	W	W
Poultry grit and mineral food	17	157	17	157	24	230
Concrete aggregate	[r]6,092	[r]17,636	4,980	16,311	4,614	16,336
Bituminous aggregate	4,421	[r]12,522	2,920	9,018	2,771	9,108
Macadam aggregate	W	W	W	W	365	1,115
Dense-graded roadbase stone	[r]13,963	[r]34,579	17,246	48,796	13,684	39,322
Surface treatment aggregate	549	1,862	2,374	7,379	3,414	10,568
Other construction aggregate and roadstone	3,850	[r]10,733	4,996	13,313	9,622	31,667
Riprap and jetty stone	232	819	574	2,213	675	2,411
Railroad ballast	2,360	5,389	2,721	6,413	2,676	7,927
Filter stone	W	W	W	W	205	549
Manufactured fine aggregate (stone sand)	224	521	450	955	688	2,110
Terrazzo and exposed aggregate	22	125	15	96	16	126
Fill	--	--	--	--	16	16
Roofing granules	--	--	25	125	20	102
Other uses[2]	1,079	2,911	1,105	3,144	1,074	3,731
Total[3]	32,810	87,254	37,687	108,867	39,864	125,319

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, marble, marl, sandstone, traprock, slate, and miscellaneous stone (1977).

[2] Includes stone used in cement manufacture, glass manufacture (1977), and other miscellaneous uses (1978-79), and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 9.—North Carolina: Dimension stone[1] sold or used by producers, by use

Use	1977			1978			1979		
	Quantity			Quantity			Quantity		
	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)
Rough stone:									
Rough blocks	3,618	44	$142	3,781	46	$155	5,187	62	$213
Irregular shaped stone	W	W	W	W	W	W	6,083	76	203
Rubble	2,078	30	31	1,787	22	25	816	10	12
Monumental	5,388	65	281	5,241	63	283	4,754	58	274
Dressed stone:									
Cut stone	2,481	31	465	2,481	31	465	3,323	42	673
Curbing	[r]14,888	186	770	14,888	186	770	19,937	249	1,113
Other uses[2]	[r]11,972	[r]141	1,352	11,504	138	1,352	8,436	98	1,445
Total[3]	40,425	498	3,041	39,682	486	3,050	48,536	594	3,932

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes granite, marble, sandstone, slate, and miscellaneous stone (1977).

[2] Includes rough flagging (1977-78), dressed construction, dressed monumental, dressed flagging, structual and sanitary fixtures, and data indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Vermiculite.—W.R. Grace & Co. exfoliated vermiculite at its plant near High Point, Guilford county. The raw material was obtained from the Grace mine in South Carolina. Output decreased substantially because of greater competition from producers of synthetic fibrous insulation material. A decline in building construction in 1979 also contributed to decreased consumption of vermiculite, which is used in concrete and plaster aggregate.

METALS

Aluminum.—Aluminum Company of America (Alcoa) produced primary aluminum at its 125,000-ton-per-year smelting plant near Badin, Stanly County. Output increased in 1978 and again in 1979. Imported bauxite was processed into alumina at Alcoa's works in Mobile, Ala., then transported to the Badin smelter for conversion to aluminum.

The Ray Magnet Wire Co., a subsidiary of Alcoa located in Laurinburg, Scotland County, manufactured aluminum and copper magnet wire.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

[2] Chief, Geology and Mineral Resources Section, Division of Earth Resources, North Carolina Department of Natural and Economic Resources, Raleigh, N.C.

[3] Wilson, W. F., and B. J. McKenzie. Mineral Collecting Sites in North Carolina. N.C. Dept. of Nat. Res. and Community Development, Div. of Land Res. Geol. Survey Sec., Inf. Circ. 24, 1978, 122 pp.

[4] McKenzie, B. J. Index to Geologic and Geophysical Mapping in North Carolina. N.C. Dept. of Nat. Res. and Community Development, Div. of Land Res., Geol. Survey Sec., 1978.

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[7] Parker, J. M., III. Geology and Mineral Resources of Wake County. N.C. Dept. of Nat. Res. and Community Development, Div. of Land Res., Geol. Survey Sec., Bull. 86, 1979, 122 pp.

[8] I. H. Redeker, Chief engineer, North Carolina State University, Minerals Researc Laboratory, 180 Coxe Ave., Asheville, N.C. 28801.

Table 10.—Principal Producers

Commodity and company	Address	Type of activity	County
Aluminum, smelter: Aluminum Co. of America	1501 AlcoaBldg. Pittsburgh, PA15219	Plant	Stanly.
Asbestos: Powhatan Mining Co	6721 Windsor Mill Rd. Baltimore, MD 21207	Open pit mine	Yancey.
Cement: Ideal Basic Industries, Inc.[1,2]	410 Ideal Cement Bldg. Denver, CO 80202	Plant	New Hanover.
Clays:			
Boren Clay Products Co	Box 368 Pleasant Garden, NC 27313	Open pit mines and plant.	Chatham, Guilford, Sampson.
Pine Hall Brick & Pipe Co	Box 11044 Winston-Salem, NC 27106	do	Rockingham and , and Stokes.
Sanford Brick Corp	Drawer 458 Sanford, NC 27256	do	Chatham, Lee, Stanly.
Solite Corp.	Box 27211 Richmond, VA 23261	do	Rockingham Stanly.
Feldspar:			
The Feldspar Corp.[1,2,3]	Box 220 Spruce Pine, NC 28777	Open pit mines and plants.	Mitchell.
International Minerals & Chemical Corp.[3]	IMC Plaza Libertyville, IL 60048	do	Do.
Lawson-United Feldspar and Minerals Co.[3]	Box 309 Spruce Pine, NC 28777	do	Do.
Lithium minerals:			
Foote Mineral Co.[1]	Box 792 Kings Mountain, NC 28086	Open pit mine and plant.	Cleveland.
Lithium Corp. of America, Inc	449 North Cox Rd. Gastonia, NC 28052	do	Gaston.
Mica:			
The Feldspar Corp.[4]	Box 99 Spruce Pine, NC 28777	Open pit mines	Mitchell.
Harris Mining Co.[1,2]	Box 628 Spruce Pine, NC 28777	do	Avery.
Kings Mountain Mica Co., Inc.[4]	Box 709 Kings Mountain, NC 28086	do	Cleveland.
Olivine: International Minerals & ChemicalCorp.	Box 672 Spruce Pine, NC 28777	do	Jackson and Yancey.
Perlite, expanded: Carolina Perlite Co.,Inc.	Box 741 Hillside, NJ 07205	Plant	Rowan.
Phosphate rock: Texasgulf, Inc.[5]	Box 48 Aurora, NC 27806	Open pit mine and plant.	Beaufort.
Pyrophyllite and talc:			
Glendon Pyrophyllite, Inc	Box 306 Carthage, NC 28327	Open pit mines and plant.	Alamance and Moore.
Hitchcock Corp	Box 459 Murphy, NC 28906	do	Cherokee.
Piedmont Minerals Co., Inc.[2]	Box 566 Hillsborough, NC 27278	Open pit mine and plant	Orange.
Standard Minerals Co., Inc	Box 278 Robbins, NC 27325	do	Moore.
Sand and gravel:			
Becker Sand & Gravel Co	Box 848 Cheraw, SC 29520	Pits	Cumberland, Harnett, Moore.
W. R. Bonsal Co.	Box 38 Lilesville, NC 28091	do	Anson.
B. V. Hedrick Gravel and Sand Co.[1]	Swannanoa, NC 28778	do	Buncombe.
Thompson-Arthur Paving Co.	Box 21088 Greensboro, NC 27420	do	Guilford, Montgomery, Moore, Rockingham.
Stone:			
Ararat Rock Products Co	223 Willow St. Mount Airy, NC27030	Quarry	Surry.
Ashland Oil, Inc., Harrison Div	Box 386 Alcoa, TN 27701	Quarries	Cherokee, Jackson, Macon.
Martin Marietta Corp	Box 30013 Raleigh, NC 27612	do	Various.
Nello L. Teer. Co	Box 1131 Durham, NC 27702	do	Do.
Vulcan Materials Co., Mideast Div	Box 7506, Reynolds Station Winston-Salem, NC 27109	do	Do.
Vermiculite expanded:			
Vermiculite, exfoliated: W. R. Grace & Co.	62 Whittemore Ave. Cambridge, MA 02140	Plant	Guilford.

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[1] Also stone.
[2] Also clays.
[3] Also mica.
[4] Also feldspar.
[5] Also gypsum.

The Mineral Industry of North Dakota

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the North Dakota Geological Survey for collecting information on all nonfuel minerals.

By James H. Aase,[1] Wanda J. West,[2] and Erling A. Brostuen[3]

The value of nonfuel mineral production in North Dakota for 1978 and 1979 was $22.1 million and $21.2 million, respectively. Sand and gravel continued as the State's leading nonfuel mineral commodity, accounting for more than 70% of the total output value in 1978 and 1979. Other nonfuel mineral commodities produced in the State during the biennium, in descending order of their production value, included salt, lime, clays, peat, and gem stones.

Nationally, North Dakota ranked in the lowest 10 percentile group of States for production values derived from nonfuel minerals in 1978-79.

On the average, approximately 65 firms and various governmental agencies, operating out of fewer than 100 locations, have accounted for nearly all of the State's nonfuel mineral production in recent years.

A severe cement shortage that plagued much of the North-Central United States during 1978 was also evident in North Dakota. The State relies exclusively on out-of-State supplies and experienced a cutback in shipments from its traditional suppliers, who were unable to meet all of North Dakota's needs. State officials, concerned that the shortage would continue, instigated a study to determine the availability of cement manufacturing resources within the State and the economic feasibility of establishing a cement industry. Results of the study released at yearend 1978 concluded that the undertaking was not economically feasible under existing conditions because of inadequate supplies of suitable raw materials and an in-State market too small to warrant production.

Table 1.—Nonfuel mineral production in North Dakota[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Gem stones	NA	$2	NA	$1	NA	$1
Peat thousand short tons	([2])	W	W	W	([2])	W
Sand and gravel do	5,821	12,102	7,407	17,170	6,648	15,128
Combined value of clays, lime, salt, and values indicated by symbol W	XX	4,672	XX	4,966	XX	6,105
Total	XX	16,776	XX	22,137	XX	21,234

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Less than 1/2 unit.

Table 2.—Value of nonfuel mineral production in North Dakota, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Barnes	$198	$165	Sand and gravel.
Benson	--	W	Do.
Bottineau	58	W	Sand and gravel, peat.
Bowman	W	W	Sand and gravel.
Burke	W	3,073	Do.
Burleigh	1,977	3,357	Do.
Cass	256	W	Do.
Dickey	79	79	Do.
Divide	54	101	Do.
Dunn	8	--	
Eddy	W	W	Sand and gravel.
Grand Forks	220	220	Do.
Griggs	W	W	Do.
Kidder	W	W	Do.
McHenry	W	W	Do.
McKenzie	118	163	Do.
McLean	803	957	Do.
Morton	W	802	Clays, sand and gravel.
Mountrail	--	W	Sand and gravel.
Pembina	W	W	Lime, sand and gravel.
Pierce	56	W	Sand and gravel.
Ramsey	--	1	Do.
Ransom	9	W	Do.
Renville	--	4	Do.
Richland	W	W	Lime, sand and gravel.
Rolette	35	88	Sand and gravel.
Sheridan	--	W	Do.
Slope	83	83	Do.
Stark	345	502	Do.
Steele	--	355	Do.
Stutsman	583	1,725	Do.
Towner	W	W	Do.
Traill	228	929	Do.
Walsh	212	173	Do.
Ward	1,321	1,376	Do.
Wells	190	190	Do.
Williams	W	W	Salt, sand and gravel.
Undistributed[2]	9,940	7,791	
Total[3]	16,776	22,137	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] The following counties are not listed because no nonfuel mineral production was reported: Adams, Billings, Cavalier, Emmons, Foster, Golden Valley, Grant, Hettinger, Logan, La Moure, McIntosh, Mercer, Nelson, Oliver, Sargent, and Sioux.

[2] Includes gem stones, sand and gravel which cannot be assigned to specific counties, and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Hardy Salt Co., the State's sole producer of salt, completed an improvement and expansion program at its Williston plant in 1978.

Program activities of the State Geological Survey during 1978 and 1979 included studies related to strip mine reclamation, geology, hydrology, and geochemistry; a study of the State's hydrothermal resources; studies of the Quaternary geology of various counties; and a study of the Williston Basin stratigraphy.

The School of Engineering and Mines of the University of North Dakota was designated by the Secretary of the Interior as a State Mining and Mineral Resources Research Institute, one of 31 spread across the Nation. The Institute is charged with both research and training functions and was established pursuant to Title III of Public Law 95-87.

Persons who, during one calendar year, disturb or remove more than 10,000 cubic yards of mineral material, or affect one-half acre or more of land in surface mining operations for minerals other than coal, must report their mining and reclamation activities to the North Dakota Soil Conservation Committee under requirements of Chapter 38-16, North Dakota Century Code. The State Soil Conservation Committee reported that during 1979 a total of 579 acres were affected by surface mining in which 5,336,219 cubic yards of minerals was mined and 698,275 cubic yards of overburden was disturbed.

In 1979, geologists from the Federal Bureau of Mines Eastern Field Operations Center in Pittsburgh, Pa., completed a 2-year program of investigation and evaluation of the lignite reserves present on the Fort Berthold Indian Reservation in North Dakota. The program, consisting of fieldwork and drilling, was initiated through an interagency agreement with the Bureau of Indian Affairs.

Table 3.—Indicators of North Dakota business activity

	1977	1978	1979^p	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	289.0	295.0	303.0	+2.7
Unemployment do	14.0	14.0	11.0	-21.4
Employment (nonagricultural):				
Mining[1] do	3.1	4.3	5.4	+25.6
Manufacturing do	15.3	15.7	16.6	+5.7
Contract construction do	16.4	18.5	18.4	-.4
Transportation and public utilities do	13.8	14.8	16.0	+8.1
Wholesale and retail trade do	62.3	64.7	67.7	+4.6
Finance, insurance, real estate do	9.9	10.5	11.0	+4.8
Services do	42.8	45.5	47.8	+5.1
Government do	57.5	60.0	60.7	+1.2
Total nonagricultural employment[1] do	221.1	234.0	[2]243.5	+4.1
Personal income:				
Total millions	$3,833	$4,845	$5,108	+5.4
Per capita	$5,895	$7,432	$7,774	+4.6
Construction activity:				
Number of private and public residential units authorized	6,486	[3]5,987	4,429	-26.0
Value of nonresidential construction millions	$93.2	$95.7	$107.5	+12.3
Value of State road contract awards do	$39.6	$65.0	$68.4	+5.2
Shipments of portland and masonry cement to and within the State thousand short tons	439	367	380	+3.5
Nonfuel mineral production value:				
Total crude mineral value millions	$16.8	$22.1	$21.2	-4.1
Value per capita, resident population	$26	$34	$32	-5.9
Value per square mile	$237	$313	$300	-4.2

^{p}Preliminary.

[1] Includes coal and oil and gas extraction.

[2] Data do not add to total shown because of independent rounding.

[3] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

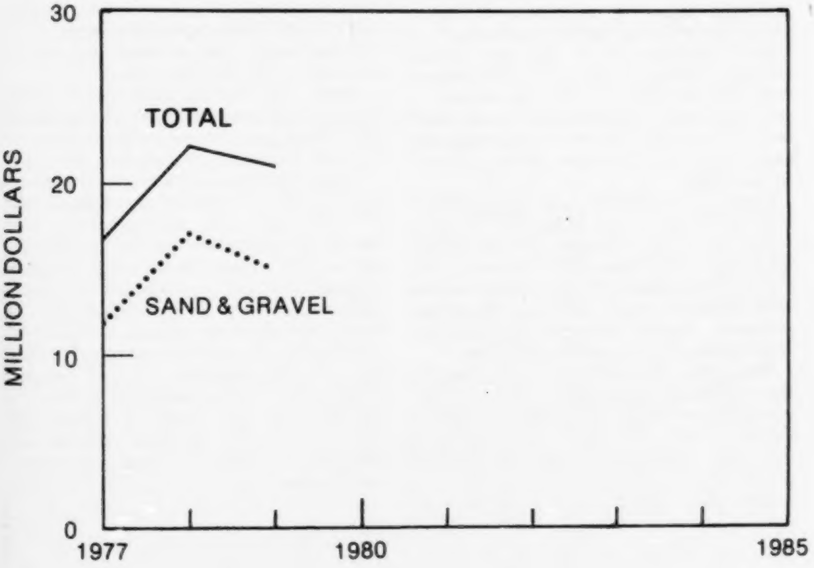

Figure 1.—Value of sand and gravel and total value of nonfuel mineral production in North Dakota.

Legislation.—The North Dakota Legislature, which meets every other year, held its 46th Legislative Assembly in 1979. A number of bills were enacted into laws of interest to the mineral industry, including:

HB-1239—Surface Mining Reclamation.—Provides for the development of a reclamation program for abandoned surface-mined areas.

HB-1250—Subsurface Mineral Regulations.—Amendment to law covering subsurface mineral regulations.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Clays.—Mining of clay for the production of brick continued throughout 1978 and 1979 at one of the oldest industries in North Dakota, the Hebron Brick Co. at Hebron in Morton County. The facility, in operation since 1904, is the only brick manufacturing plant in the State and turns out more than 1 million pieces of fired brick each month in about 50 different colors and varieties. Clay is mined a few miles from the plant site and includes two basic types—white sandy clay for light-colored brick and dark plastic clay for darker colored brick. The company employed about 50 workers and marketed its product nationwide through a network of distributors.

U.S. Noonlite, Ltd., mined clay from a deposit near Mandan in Morton County for its use in manufacturing lightweight aggregate during 1978 and 1979. The aggregate produced was used in concrete blocks, structural concrete, and highway surfacing.

Gem Stones.—All of the State's gem stone production in 1978 and 1979 resulted from the recreational activities of mineral collectors and other hobbyists. Agate, chalcedony, and petrified wood are among the principal semiprecious gem stones collected in the State.

Lime.—American Crystal Sugar Co. in Pembina County and Minn-Dak Farmers Co-op. in Richland County were the State's only producers of lime in the biennium. The entire lime output of the two companies was used in their sugar refining operations. Limestone used in producing the quicklime was obtained from out-of-State sources.

Peat.—Peat Products Co., accounting for the total State peat output in 1978 and 1979, produced reed-sedge peat from bogs in Bottineau County. The peat was marketed in both bulk and packaged form and was used principally for horticultural purposes.

Salt.—The Hardy Salt Co., located near Williston in Williams County, was the State's sole producer of salt in the biennium 1978-79. All production was obtained by solution-mining methods. The company's finished products included table salt and water softener salt for home use, various trace mineral salt products for livestock, special salts for food processors, and brine and drilling salt for use by the petroleum industry.

Improvements and expansions were made to the company's plant in 1978. The project included the construction of an 8-acre cooling pond and a new well to provide a better water supply at the plant; construction of two 1-million-gallon brine tanks to quadruple the aboveground brine storage capacity and to assure a continuous supply of brine to the evaporating plant during periods when maintenance work is being done on the brine well; conversion of the boiler to burn either natural gas or fuel oil; installation of fuel storage tanks; and construction of 9,000 square feet of additional storage capacity for the finished product.

Sand and Gravel.—Sand and gravel accounted for more than 70% of the value of all nonfuel mineral commodities produced in North Dakota in the biennium 1978-79.

North Dakota's sand and gravel industry has operations widely scattered throughout the State that vary significantly in their individual production output, as exemplified in 1978, when 58 firms and government agencies produced sand and gravel from 85 deposits located in 36 counties. Production from the individual deposits ranged from less than 25,000 tons to more than 1 million tons, with 38% reporting output of less than 25,000 tons, 33% between 25,000 and 100,000 tons, 19% between 100,000 and 200,000 tons, 9% between 200,000 and 500,000 tons, and the remainder over 1 million tons.

Table 4.—North Dakota: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,540	$4,658	$3.02	2,826	$8,638	$3.06	1,446	$5,008	$3.46
Plaster and gunite sands	NA	NA	NA	W	W	W	100	437	4.36
Concrete products	213	673	3.16	240	688	2.86	201	685	3.41
Asphaltic concrete	747	1,571	2.10	1,116	2,219	1.99	1,113	2,173	1.95
Roadbase and coverings	2,471	4,035	1.63	2,341	4,030	1.72	2,318	4,231	1.82
Fill	823	1,080	1.31	783	1,234	1.58	1,447	2,498	1.73
Snow and ice control	NA	NA	NA	W	W	W	([1])	2	5.00
Railroad ballast	W	W	W	12	49	4.00	12	49	4.00
Other uses	27	84	2.32	20	58	2.90	10	45	4.54
Total[2] or average	5,821	12,102	2.08	7,407	17,170	2.32	6,648	15,128	2.28

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses" and/or "Total."

[1] Less than 1/2 unit.

[2] Data may not add to totals shown because of independent rounding.

Table 5.—North Dakota: Sand and gravel sold or used by producers

	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	2,249	$4,628	$2.06	2,498	$6,100	$2.44	2,333	$5,247	$2.25
Gravel	3,572	7,473	2.09	4,909	11,066	2.25	4,315	9,881	2.29
Total[1] or average	5,821	12,102	2.08	7,407	17,170	2.32	6,648	15,128	2.28

[1] Data may not add to totals shown because of independent rounding.

Table 6.—North Dakota: Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1977			1978			1979		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Barnes	2	149	198	1	111	165	2	W	241
Bottineau	2	38	58	2	38	58	2	W	W
Burke	2	W	W	2	W	3,073	2	W	W
Burleigh	3	545	1,977	7	982	3,357	8	1,094	3,694
Cass	2	W	256	2	W	W	1	W	W
Dickey	1	53	79	1	53	79	1	53	79
Divide	1	36	54	1	62	101	1	48	81
Dunn	1	5	8	--	--	--	1	2	4
Eddy	2	W	W	2	W	W	3	425	914
Grand Forks	2	143	220	2	143	220	2	W	W
McKenzie	1	118	118	1	W	163	1	W	166
McLean	4	449	803	5	409	957	5	400	930
Morton	2	W	W	2	W	W	3	611	976
Mountrail	--	--	--	2	W	W	3	577	1,358
Pierce	1	37	56	3	W	W	3	W	W
Ramsey	--	--	--	1	1	1	--	--	--
Ransom	1	W	9	1	W	W	2	W	W
Renville	--	--	--	1	4	4	2	W	W
Richland	1	9	14	3	137	225	2	W	68
Rolette	1	23	35	1	68	88	1	57	57
Slope	1	55	83	1	55	83	--	--	--
Stark	3	137	345	4	219	502	3	W	W
Steele	--	--	--	1	143	355	--	--	--
Stutsman	5	314	583	8	726	1,725	8	224	758
Traill	4	158	228	4	478	929	4	231	414

See footnotes at end of table.

Table 6.—North Dakota: Sand and gravel sold or used by producers, by county —Continued

(Thousand short tons and thousand dollars)

County	1977			1978			1979		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Walsh	4	141	212	3	111	173	6	291	478
Ward	4	753	1,321	8	751	1,376	6	864	1,647
Wells	2	110	190	2	110	190	--	--	--
Undistributed[1]	12	2,548	5,258	14	2,805	3,343	13	1,770	3,260
Total[2]	64	5,821	12,102	85	7,407	17,170	85	6,648	15,128

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes Benson (1978), Bowman, Foster (1979), Griggs (1977-78), Kidder, McHenry, Pembina, Sheridan (1978), Towner, and Williams Counties, sand and gravel that cannot be assigned to specific counties (1977), and data indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Sulfur.—Elemental sulfur was recovered as a byproduct at the natural gas processing plant of Aminoil USA, Inc., at Tioga in Williams County.

Vermiculite.—Vermiculite mined out-of-State was exfoliated at the plant of Robinson Insulation Co. at Minot in Ward County. The exfoliated material was used as aggregate in concrete and plaster, loose fill insulation, block insulation, and soil conditioner.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Clays:			
Hebron Brick Co	Hebron, ND 58638	Pit and plant	Morton.
U.S. Noonlite, Ltd	Box 117 Mandan, ND 58554	do	Do.
Lime:			
American Crystal Sugar Co	101 North 3d St. Moorhead, MN 56506	Shaft kiln at beet sugar refinery.	Pembina.
Minn-Dak Farmers Co-op	Wahpeton, ND 58075	do	Richland.
Peat:			
Peat Products Co	821 4th St. Bismarck, ND 58501	Bog	Bottineau.
Salt:			
Hardy Salt Co	Box 728 Williston, ND 58801	Brine well and plant	Williams.
Sand and gravel:			
Ames Sand & Gravel, Inc	Box 2702 Fargo, ND 58102	Pit and plant	Burke.
Dakota Sand & Gravel	Box 22 Bismarck, ND 58501	do	Burleigh.
Leon Dux, Inc	Box 262 Hillsboro, ND 58045	do	Traill.
Everett & Associates, Inc	Box 1077 Jamestown, ND 58401	Pits and plants	Stutsman.
Fisher Sand & Gravel Co	Box 1034 Dickinson, ND 58601	do	Bowman, McLean, Stark.
Minot Sand & Gravel	Box 116 Minot, ND 58701	Pit and plant	Ward.
Missouri River Sand & Gravel	Box 175 Bismarck, ND 58501	do	Burleigh.
Northern Improvement Co	Box 1254 Bismarck, ND 58501	Pits and plants	Do.
Schriock Construction Co	Route 3, Radio City Minot, ND 58701	Pit and plants	Mountrail and Ward.
Sheyenne Sand & Gravel, Inc	Box 178 Sheyenne, ND 58374	Pit and plant	Eddy.
Susag Sand & Gravel, Inc	Crosby, ND 58730	Pits and plants	Bottineau, Wells, Williams.
Sulfur, recovered elemental:			
Aminoil USA, Inc	Tioga, ND 58852	Plant	Williams.
Vermiculite, exfoliated:			
Robinson Insulation Co	Box 1782 Minot, ND 58702	do	Ward.

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The Mineral Industry of Ohio

By Donald K. Harrison[1]

The value of Ohio's nonfuel mineral production was $553 million in 1978 and $607 million in 1979. Value continued to increase, reaching record highs in 1978 and again in 1979. Nonfuel mineral producers provided more than $2.5 million in severance taxes to the State's treasury during the biennium.

In 1979, Ohio ranked first in the Nation in the production of iron and steel slag, ferroalloys, and lime; second in iron blast furnace slag; third in common clay; fourth in salt; fifth in sand and gravel; and sixth in crushed and dimension stone. The State also ranked third in iron and steel output, producing more than 21 million short tons of raw steel and 14 million short tons of pig iron.

Table 1.—Nonfuel mineral production in Ohio[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:						
Masonry --- thousand short tons	186	$8,875	196	$10,955	170	$10,869
Portland ---do---	1,970	65,899	2,022	75,637	1,921	87,483
Clays ---do---	3,568	12,835	3,778	15,394	3,374	13,495
Gypsum ---do---	W	W	171	1,375	W	W
Lime ---do---	3,199	111,100	3,467	129,316	3,392	141,663
Peat ---do---	15	107	10	90	8	191
Salt ---do---	3,701	63,485	3,897	74,572	4,135	79,598
Sand and gravel ---do---	46,521	100,736	47,158	112,157	45,944	121,048
Stone:						
Crushed ---do---	44,853	116,409	49,316	130,472	50,717	149,819
Dimension ---do---	147	3,557	90	3,295	50	1,702
Combined value of abrasives, gem stones, and values indicated by symbol W	XX	1,336	XX	86	XX	1,452
Total	XX	484,339	XX	553,349	XX	607,320

W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Ohio, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978, in order of value
Adams	W	W	Stone.
Allen	$2,394	$2,732	Do.
Ashland	W	W	Sand and gravel, clays.
Ashtabula	W	W	Lime, sand and gravel.
Athens	W	W	Stone, sand and gravel.
Auglaize	W	W	Sand and gravel, stone, clays.
Belmont	W	W	Sand and gravel, stone.
Brown	W	387	Stone, sand and gravel.
Butler	5,171	7,051	Sand and gravel.
Carroll	362	580	Stone, sand and gravel.
Champaign	W	486	Sand and gravel, peat.
Clark	W	W	Sand and gravel, stone.
Clermont	W	W	Do.
Clinton	W	W	Stone.
Columbiana	W	W	Clays, sand and gravel, stone.
Coshocton	W	W	Sand and gravel, stone.
Crawford	W	W	Stone.
Cuyahoga	W	24,313	Salt, lime, clays, peat.
Darke	942	968	Sand and gravel, clays.
Defiance	4	--	
Delaware	2,618	3,240	Stone, clays.
Erie	W	W	Lime, stone, sand and gravel.
Fairfield	W	W	Sand and gravel.
Fayette	W	W	Stone, sand and gravel.
Franklin	W	W	Sand and gravel, stone, clays.
Gallia	W	W	Sand and gravel.
Geauga	W	W	Sand and gravel, stone.
Greene	25,385	29,672	Cement, sand and gravel, stone, clays.
Guernsey	W	W	Stone.
Hamilton	8,992	9,921	Sand and gravel.
Hancock	W	1,618	Stone.
Hardin	W	W	Do.
Harrison	W	W	Stone, clays.
Henry	W	W	Sand and gravel, clays.
Highland	1,747	1,816	Stone, sand and gravel.
Hocking	282	295	Sand and gravel, clays.
Holmes	W	W	Stone, sand and gravel, clays.
Huron	W	W	Sand and gravel, stone.
Jackson	W	W	Clays, stone, sand and gravel.
Jefferson	1,607	W	Clays.
Knox	W	W	Sand and gravel, stone.
Lake	W	W	Salt, lime, sand and gravel.
Lawrence	10,121	W	Cement, clays, sand and gravel.
Licking	W	W	Sand and gravel, clays.
Logan	W	W	Stone, sand and gravel, peat.
Lorain	17,684	17,853	Lime, stone, sand and gravel, grindstones.
Lucas	W	W	Stone, cement, sand and gravel, clays.
Madison	W	W	Stone, sand and gravel.
Mahoning	W	W	Stone, clays, peat.
Marion	2,462	W	Stone, sand and gravel, clays.
Medina	W	W	Sand and gravel, clays, stone.
Meigs	4,415	4,003	Sand and gravel.
Mercer	W	W	Stone.
Miami	4,476	4,990	Stone, sand and gravel.
Monroe	W	W	Stone.
Montgomery	W	W	Sand and gravel, stone.
Morgan	W	W	Sand and gravel.
Morrow	184	214	Do.
Muskingum	W	W	Cement, stone, sand and gravel, clays.
Noble	W	660	Stone.
Ottawa	W	W	Stone, lime, gypsum.
Paulding	W	W	Cement, stone, clays.
Perry	W	W	Stone, sand and gravel, clays.
Pickaway	W	W	Sand and gravel, stone.
Pike	W	W	Do.
Portage	7,698	9,746	Sand and gravel.
Preble	W	773	Sand and gravel, stone.
Putnam	603	W	Stone, clays.
Richland	W	W	Sand and gravel, clays.
Ross	W	W	Sand and gravel, stone.
Sandusky	64,624	71,964	Lime, stone.
Scioto	W	W	Sand and gravel, clays, stone.
Seneca	W	W	Lime, stone, clays.
Shelby	W	1,291	Sand and gravel, stone.
Stark	W	W	Sand and gravel, cement, stone, clays.
Summit	W	W	Salt, sand and gravel, stone.
Trumbull	W	W	Sand and gravel, stone.
Tuscarawas	W	W	Sand and gravel, clays, stone.
Union	W	W	Stone.
Van Wert	1,353	1,496	Do.
Vinton	8	W	Stone, clays.
Warren	W	W	Sand and gravel, stone.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Ohio, by county[1] —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978, in order of value
Washington	$925	$1,884	Sand and gravel, stone.
Wayne	26,070	W	Salt, sand and gravel, stone, clays.
Williams	W	W	Sand and gravel, peat.
Wood	3,253	4,008	Stone.
Wyandot	W	W	Stone, lime, sand and gravel, clays, peat.
Undistributed[2]	290,964	351,396	
Total[3]	484,339	553,349	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Fulton County is not listed because no nonfuel mineral production was reported.

[2] Includes gem stones, sand and gravel, and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Ohio business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	4,810.0	4,937.0	5,036.0	+2.0
Unemployment	do	311.0	267.0	297.0	+11.2
Employment (nonagricultural):					
Mining[1]	do	29.1	29.0	31.8	+9.7
Manufacturing	do	1,344.1	1,377.2	1,380.1	+.2
Contract construction	do	162.8	176.6	184.3	+4.4
Transportation and public utilities	do	219.1	225.0	233.5	+3.8
Wholesale and retail trade	do	917.8	956.3	981.5	+2.6
Finance, insurance, real estate	do	183.4	191.1	199.7	+4.5
Services	do	731.4	772.1	810.5	+5.0
Government	do	642.3	667.5	673.9	+1.0
Total nonagricultural employment[1]	do	[2]4,230.1	4,394.8	4,495.2	+2.3
Personal income:					
Total	millions	$75,968	$84,456	$94,162	+11.5
Per capita		$7,102	$7,857	$8,775	+11.7
Construction activity:					
Number of private and public residential units authorized		60,844	[3]59,935	47,765	-20.3
Value of nonresidential construction	millions	$984.9	$1,179.0	$1,463.2	+24.1
Value of State road contract awards	do	$200.0	$330.0	$365.0	+10.6
Shipments of portland and masonry cement to and within the State	thousand short tons	3,422	3,671	3,410	-7.1
Nonfuel mineral production value:					
Total crude mineral value	millions	$484.3	$553.3	$607.3	+9.7
Value per capita, resident population		$45	$51	$57	+11.8
Value per square mile		$11,750	$13,424	$14,733	+9.7

[p] Preliminary.

[1] Includes bituminous coal and gas extraction.

[2] Data do not add to total shown because of independent rounding.

[3] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

The processing and refining of mineral raw materials produced in-State played an important role in the State's manufacturing economy. In addition, imported mineral commodities such as alumina, beryllium, iron ore, perlite, titanium, vermiculite, and zirconium were processed into high-value finished products. Ohio's mineral producing and processing industries contributed more than $16 billion in production value to the State's gross product; these industries included steel, glass, cement, fabricated metals, and steel foundries.

Trends and Developments.—Although 1978 and 1979 were record years for the extractive nonfuel mineral industry, they

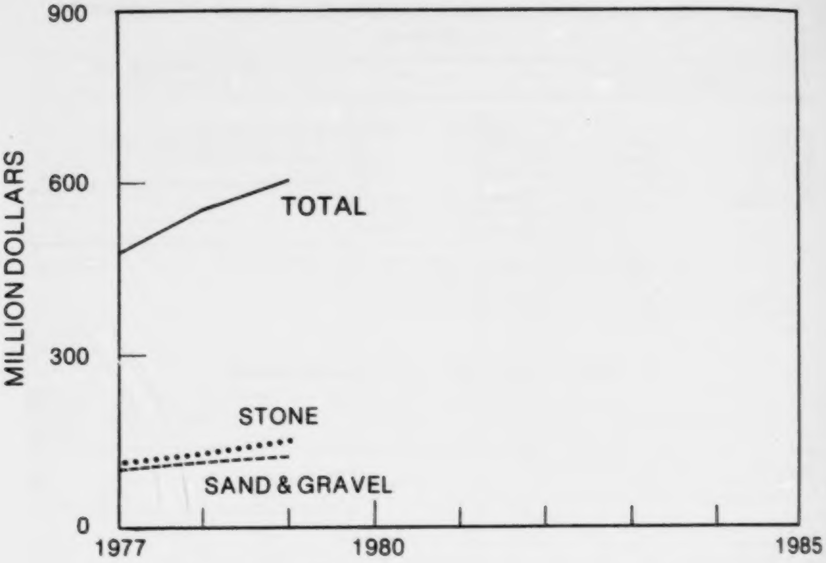

Figure 1.—Value of sand and gravel, and stone, and total value of nonfuel mineral production in Ohio.

constituted a period of crisis for the glass industry in Columbus and the steel industry in the Youngstown-Warren area.

In early 1979, the 79-year-old Federal Glass Co. in Columbus closed, resulting in the loss of 1,500 jobs and an annual payroll of $25 million. Even with annual sales estimated at $55 million, the company lost $3.5 million in 1978. Employees' efforts to purchase and operate the facility were unsuccessful.

Late in 1977, Youngstown Sheet & Tube Co., a subsidiary of Lykes Corp., closed its Campbell, Ohio, works, idling 4,100 workers. In 1978, the merger of Lykes Corp. and LTV Corp., owner of Jones & Laughlin Steel Corp., was approved. Subsequently, four open-hearth furnaces at the Brier Hill complex were closed, resulting in the loss of more than 1,200 additional jobs.

In April 1979, Republic Steel Corp. began construction of a $20 million automated ore dock near the mouth of the Black River in Lorain, with completion scheduled for the 1980 Great Lakes shipping season. The new dock is expected to increase handling capabilities and facilitate the unloading of 1,000-foot ore carriers. Lorain's ore-handling capacity is projected to increase from 2.6 million tons to nearly 8 million tons annually.

In March 1979, RMI Co., one of the leading producers of titanium, began to expand its titanium-reduction facility in Ashtabula. The $3.5 million expansion, scheduled for completion in 1980, is expected to increase the company's capacity for production of titanium sponge by about 25%.

Legislation and Government Programs.—Substitute House Bill 504, which became effective in March 1979, amended the Ohio Surface Mining and Reclamation Law for nonfuel mining. The revisions eliminated the need for a permit by operators who remove minerals from a depth of 10 feet or less and disturb less than one acre during 12 successive calendar months, relieved operators mining less than 10,000 tons per year from mapping requirements, instituted a minimum filing fee of $2,000, and deleted the requirement for operation insurance coverage.

In July 1978, Ohio became a member of

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the Interstate Mining Compact Commission. The Ohio Mining Council was created to serve as the advisory body to the State's representative on the commission.

The Ohio Department of Natural Resources, Division of Reclamation, issued 111 nonfuel mining permits in 1978 and 79 in 1979, and provided bonding for nearly 5,000 acres. The division released a total of 786 acres for regrading and 571 acres for revegetation for both years. Total number of active permits as of December 31, 1979, was 660.

During 1978-79, the Ohio Division of Geological Survey (DGS) of the Ohio Department of Natural Resources published a number of reports on mineral- and energy-related topics. Projects underway included remote-sensing fracture analyses in eastern Ohio; geochemical and petrographic studies of Devonian shales, glacial, and surficial mapping in northeastern Ohio; and Lake Erie shore-erosion studies. Also, the DGS was developing a series of maps depicting geological and mineral resource data for a number of counties in planning and land-capability analyses.

In late 1978, the Secretary of the Interior designated Ohio State University as a State Mining and Mineral Resources and Research Institute under Title III of Public Law 95-87. Ohio State, one of 31 schools and universities in the Nation selected to establish training programs in mining and minerals extraction, is scheduled to receive annual allotments through 1984. The University initially received a basic grant of $110,000, plus $160,000 for scholarships and fellowships.

Twenty-six Federal Bureau of Mines contracts totaling more than $6.3 million were either ongoing or completed in the State during 1978 and 1979. These contracts were awarded to State and local agencies, universities, research institutions, public utilities, and private industries. They were concerned with coal mine health and safety, metal and nonmetal mining and processing, health and safety, mining environmental research, advancing metal and nonmetal technology, and environmental protection.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasives.—Cleveland Quarries Co. continued to produce grindstone as a byproduct of sandstone quarrying operations at Amherst in Lorain County. Production fell slightly in 1978, but increased in 1979. Also, manufactured metallic abrasives, such as iron and steel shot and grit, were produced by three companies at four plants in Lucas and Cuyahoga Counties.

Cement.—Six companies operated six cement plants in Ohio during 1978-79. Portland cement was produced at all the plants; four also produced masonry cement. The bulk of the portland cement shipped was Type I (general construction use) and Type II (moderately low heat and moderate degree of resistance to sulfate attack). Both the dry and wet grinding processing methods were used.

In 1978-79, a severe cement shortage curtailed a great deal of commercial, residential, and highway construction within the State. The cement industry attributed the shortage largely to regulations of the U.S. Environmental Protection Agency, which required the industry to install pollution abatement equipment. Several plants that could not comply with the pollution requirements because of the costs involved were shut down. The largest concrete supplier in Cleveland was forced to close temporarily, affecting 150 jobs. In 1979, the cement and construction industries were also affected by a 4-month concrete hauler strike.

Table 4.—Ohio: Portland cement salient statistics

(Short tons)

	1978	1979
Number of active plants	6	6
Production	2,014,367	2,044,852
Shipments from mills:		
Quantity	2,022,287	1,921,136
Value	$75,637,187	$87,482,881
Stocks at mills, Dec. 31	13,405	210,996

Table 5.—Ohio: Masonry cement salient statistics

(Short tons)

	1977	1978
Number of active plants	4	4
Production	188,933	177,927
Shipments from mills:		
Quantity	195,538	170,285
Value	$10,955,286	$10,868,972
Stocks at mills, Dec. 31	8,910	17,784

In a positive development, researchers at Battelle Memorial Institute developed a use for cement-kiln dust, which has been a major nuisance and source of pollution. Dust is converted to a slurry in a rotating drum, producing pellets with applications as fertilizers and soil conditioners, roadbase material, lightweight gravel for concrete, and as a sulfur dioxide absorption agent for pollution control.

Clays.—Ohio ranked sixth in the Nation in the value of common clay and shale output in 1979; having dropped from first place in 1976. The State had more than 60 companies operating nearly 90 pits in 34 counties. Of the total clays produced, approximately 80% was common clay and the remainder was fire clay. Major end products were drain tile, refractories, quarry tile, face brick, concrete block, and portland cement.

Gem Stones.—The collection of gem and mineral specimens continued to be a popular pastime in the State. Flint, the State's official gem stone; calcite; celestite; and jasper were some of the more sought-after minerals. The combined value of gem and mineral specimens collected in the State during 1978-79 was approximately $10,000.

Graphite (Synthetic).—The Ohio Carbon Co. produced synthetic graphite at its plant in Cleveland. Major raw materials were petroleum and pitch coke. The synthetic graphite was shaped for use in electrical motor brushes.

Gypsum.—National Gypsum Co., United States Gypsum Co., and Celotex Corp. calcined gypsum in Lorain and Ottawa Counties in the northern part of the State. The calcined gypsum was used in the manufacture of wallboard.

Lime.—Ohio led the Nation in the production of lime, producing more than 3 million tons per year in 1978 and 1979. The State's lime industry was comprised of 15 companies with operations in 9 counties. Leading counties were Sandusky, Lorain, Lake, Seneca, and Erie. Sandusky County, with seven operating companies, accounted for nearly 40% of the State's output in 1978-79. The lime was used principally in steelmaking furnaces, refractories, and glass.

In late 1979, the National Gypsum Co.'s Gibsonburg dolomitic lime plant in Sandusky County was sold to Steetley Industries Ltd. of Hamilton, Ontario, Canada. The 75,000-ton-per-year plant had been closed since the end of 1978.

Table 6.—Ohio: Lime sold or used by producers, by use

Use	1977		1978		1979	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Steel, BOF	1,756,000	$59,123	1,899,020	$68,232	1,980,394	$82,697
Refractory dolomite	529,600	20,838	617,463	26,872	438,030	18,291
Glass	198,900	6,696	206,236	7,410	152,540	6,370
Steel, electric	94,450	3,180	91,473	3,287	118,984	4,969
Finishing lime	78,750	2,945	88,530	3,230	W	W
Mason's lime	W	W	66,644	2,431	W	W
Steel, open-hearth	W	W	W	W	34,454	1,439
Sewage treatment	41,950	1,413	53,417	1,919	23,781	993
Agriculture	W	W	10,230	345	9,130	381
Other uses[1]	499,000	16,905	434,102	15,590	635,186	26,524
Total[2]	3,199,000	111,100	3,467,000	129,316	3,392,499	141,663

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes calcium carbide, fertilizer, food and food byproducts (1979), magnesite, other chemical and industrial uses, other construction lime, other metallurgy (1977), rubber (1977), soil stabilization, sugar refining, water purification, and uses indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Perlite (Expanded).—Crude perlite, shipped from mines in the Western States, was expanded by United States Gypsum Co. in Ottawa County, National Gypsum Co. at its plant in Lorain County, Celotex Corp. at Lockland in Hamilton County, and Cleveland Builders Supply Co. at Cleveland in Cuyahoga County. Principal uses of the perlite were for construction and horticultural aggregate, cavity-fill insulation, plaster, and acoustical tile.

Quartz Crystals (Synthetic).—Ohio is the leading producer of cultured quartz for telecommunications equipment, television, and timepieces. Sawyer Research Products, Inc., a subsidiary of Brush Wellman, Inc., is the world's largest producer, with a plant at Eastlake in Lake County. In 1979, Sawyer Research purchased Crystal Systems, Inc., located at Chardon in Geauga County. Cultured quartz crystal was also produced by the Bliley Electric Co. at Cortland in Trumbull County.

Salt.—Ohio ranked fourth nationally in salt production in 1978 and 1979. Four firms with five operations sold or used salt in the forms of rock and brine. Rock salt was recovered from underground mines in Cuyahoga and Lake Counties. Brine was pumped from wells in Summit and Wayne Counties and evaporated by both the open-pan and vacuum processes. The salt was used mainly for ice control on highways, chemical applications, and human and animal consumption.

During the winter of 1978 and 1979, a number of communities in Ohio experienced rock salt shortages, which caused prices to increase substantially in some areas. The main causes of the shortage were a 3-month strike and shutdown of International Salt Co.'s mine at Cleveland and heavy demand during the previous winters, which prevented a buildup of stockpiles.

Sand and Gravel.—The tonnage of sand and gravel produced, the prime indicator of building construction activity, was virtually unchanged in 1978-79. The value of building contracts increased only 3% in Ohio compared with almost 12% for the Nation.

Ohio ranked fifth nationally in sand and gravel production in both 1978 and 1979. In 1978, there were 274 companies operating 310 deposits and 284 plants in 63 counties. The industry was similarly structured in 1979. In both years, construction sand and gravel accounted for over 95% of the total production, and industrial sand accounted for the remainder. The output of construction sand and gravel exceeded 3 million short tons in each of 4 counties: Hamilton, Butler, Portage, and Franklin. Warren and Montgomery Counties each produced more than 2 million short tons. Principal uses were for concrete aggregate, highway construction and paving, and fill.

Table 7.—Ohio: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	20,237	$43,805	$2.16	18,669	$41,432	$2.22	18,823	$44,559	$2.37
Plaster and gunite sands	NA	NA	NA	497	1,154	2.32	340	884	2.60
Concrete products	2,305	5,258	2.28	2,192	5,383	2.46	1,834	4,920	2.68
Asphaltic concrete	8,830	18,407	2.08	8,983	20,804	2.32	7,915	20,412	2.58
Roadbase and coverings	6,964	14,060	2.02	8,043	18,219	2.27	7,104	17,880	2.52
Fill	6,224	8,821	1.42	5,873	9,666	1.65	6,420	10,881	1.69
Snow and ice control	NA	NA	NA	370	858	2.32	574	1,225	2.13
Railroad ballast	W	W	W	--	--	--	--	--	--
Other uses	888	1,872	2.11	1,218	3,208	2.63	1,209	4,126	3.41
Total[1] or average	45,448	92,224	2.03	45,843	100,724	2.20	44,218	104,888	2.37

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."

[1]Data may not add to totals shown because of independent rounding.

Table 8.—Ohio: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	19,858	$38,507	$1.94	21,714	$45,045	$2.07	20,449	$45,070	$2.20
Gravel	25,589	53,716	2.10	24,130	55,679	2.31	23,769	59,819	2.52
Total[1] or average	45,448	92,224	2.03	45,843	100,724	2.20	44,218	104,888	2.37
Industrial:									
Sand	W	W	W	1,307	11.389	8.71	1,383	14,080	10.18
Gravel	W	W	W	7	44	6.13	342	2,080	6.08
Total[1] or average	1,073	8,513	7.93	1,315	11,433	8.70	1,726	16,160	9.37
Grand total[1] or average	46,521	100,736	2.17	47,158	112,157	2.38	45,944	121.048	2.63

W Withheld to avoid disclosing company proprietary data; included in "Total."

[1]Data may not add to totals shown because of independent rounding.

Table 9.—Ohio: Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Ashland	180	350	216	476	257	621
Ashtabula	255	421	245	579	170	480
Athens	271	574	162	392	141	379
Auglaize	381	708	437	961	W	W
Brown	W	W	67	168	55	100
Butler	2,854	5,171	3,804	7,051	3,719	7,743
Carroll	W	25	W	12	W	13
Champaign	254	464	266	478	265	517
Clark	1,112	1,973	1,181	2,120	1,107	2,224
Clermont	W	W	W	W	81	304
Columbiana	125	321	130	332	W	W
Coshocton	536	1,000	552	1,174	253	663
Darke	393	942	399	964	374	909
Defiance	2	4	--	--	--	--
Erie	114	379	153	480	118	463
Fayette	--	--	W	W	W	W
Franklin	2,721	5,375	3,229	6,650	3,628	7,971
Geauga	867	2,616	1,370	5,962	1,827	9,174
Greene	1,110	2,136	1,256	2,620	1,190	2,778
Hamilton	4,402	8,992	4,483	9,921	4,382	10,546
Henry	68	170	81	219	60	W
Highland	21	31	19	37	33	50
Hocking	111	201	118	228	W	W
Holmes	W	266	W	W	162	W
Huron	382	778	W	W	172	522
Jackson	16	88	17	85	16	94
Knox	1,015	4,233	999	4,292	753	3,801
Lake	W	171	W	277	W	284
Lawrence	W	W	66	141	66	141
Licking	593	1,038	640	1,131	1,230	2,950
Logan	267	451	211	367	202	412
Lucas	555	903	W	W	W	W
Madison	W	W	W	W	--	--
Marion	232	505	222	506	167	463
Medina	895	1,689	1,028	2,106	1,062	2,497
Meigs	1,835	4,415	1,667	4,003	1,437	4,067
Miami	763	1,414	671	1,290	683	1,354
Montgomery	1,987	3,785	2,390	5,114	2,686	5,929
Morrow	98	184	101	214	96	242
Pickaway	379	667	W	W	W	W
Pike	337	652	409	848	657	1,382
Portage	3,465	7,698	3,633	9,746	3,371	9,747
Preble	W	W	366	733	326	759
Richland	715	1,373	703	1,488	677	1,458
Ross	496	1,185	761	1,594	753	1,653
Scioto	436	860	542	1,106	574	1,292
Shelby	280	507	327	693	328	687
Stark	1,888	4,546	2,003	5,317	1,439	4,461
Summit	1,421	2,962	1,161	2,488	1,087	2,673
Tuscarawas	1,498	3,136	1,765	4,363	1,624	4,758
Warren	1,474	2,991	2,145	4,575	2,504	5,570
Washington	372	846	609	1,816	442	1,332
Wayne	560	1,046	628	1,298	625	1,413
Williams	426	752	393	805	430	1,121
Wyandot	400	714	211	441	195	459
Undistributed[1]	7,949	19,032	5,325	14,802	4,526	14,592
Total[2]	46,521	100,736	47,158	112,157	45,944	121,048

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes Belmont, Fairfield, Gallia, Lorain, Morgan, Muskingum, Perry, and Trumbull Counties and sand and gravel that cannot be assigned to specific counties.

[2] Data may not add to totals shown because of independent rounding.

Slag (Iron Blast Furnace).—Ohio was the Nation's second leading producer, after Pennsylvania, of blast furnace slag. Iron production facilities in the State generated 5,340,000 short tons of slag valued at $19 million in 1978 and 5,157,000 short tons valued at $20 million in 1979.

Screened, air-cooled iron blast furnace slag comprised over 80% of the total tonnage processed; granulated and expanded slag made up the remainder. Air-cooled slag was used as a roadbase aggregate; as a bituminous aggregate; and as a raw material for mineral-wool insulation. It was also used for roofing aggregate, railroad ballast, filter mediums, and septic tank absorption beds. Granulated slag was used in the manufacture of cement, as a highway base and fill, as an aggregate for concrete products, and in agriculture liming and soil conditioning. Expanded slag was used as an aggregate in the manufacture of lightweight concrete, concrete products, and masonry units.

Stone.—Ohio ranked sixth nationally in total stone production in 1978-79. Limestone and sandstone were the two major types produced, with limestone accounting for over 95% of the total output in both years. In 1979, the State's stone industry was comprised of 122 crushed limestone quarries and 21 crushed sandstone quarries. In the same year, there were 21 dimension sandstone quarries and 1 dimension limestone quarry in the State. Primary uses for crushed stone were for concrete aggregate, highway construction and paving fill, and concrete products. Trucks transported nearly 75% of all construction stone; the remainder was shipped by rail and barge.

Table 10.—Ohio: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	[r]1,693	5,370	1,847	6,021	1,647	6,038
Poultry grit and mineral food	--	--	--	--	15	43
Concrete aggregate	[2]7,247	[2,r]16,527	7,333	17,676	8,432	22,731
Bituminous aggregate	[r]3,842	9,182	3,441	8,647	3,546	9,731
Macadam aggregate	4,195	9,494	4,908	11,819	4,304	11,287
Dense-graded roadbase stone	4,639	[r]11,185	4,497	11,297	5,613	16,019
Surface treatment aggregate	2,214	[r]5,459	2,096	5,788	2,044	6,548
Other construction aggregate and roadstone	6,699	[r]15,872	10,076	25,257	9,222	25,959
Riprap and jetty stone	761	2,077	829	2,587	50	1,454
Railroad ballast	977	2,067	1,168	2,551	1,163	2,769
Filter stone	73	[r]136	W	W	8	30
Manufactured fine aggregate (stone sand)	W	W	650	1,541	993	2,634
Cement manufacture	2,921	8,237	3,189	9,389	3,407	11,505
Lime manufacture	[3]3,949	7,349	2,831	6,235	3,604	8,588
Dead-burned dolomite	W	W	919	1,945	972	2,164
Flux stone	3,461	8,679	3,776	9,169	3,631	9,649
Refractory stone	366	1,704	385	2,241	361	3,723
Mine dusting	W	W	W	w	56	589
Other fillers	280	3,121	166	1,694	167	1,776
Glass manufacture	904	6,534	482	3,561	450	3,639
Other uses[4]	631	3,417	725	3,054	571	2,940
Total[5]	44,853	116,409	49,316	130,472	50,717	149,819

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone and sandstone.

[2] Includes manufactured fine aggregate (stone sand).

[3] Includes dead-burned dolomite and chemical stone.

[4] Includes stone used for agricultural marl and other soil conditioners, terrazzo and exposed aggregate, ferrosilicon, chemical stone (1978), asphalt filler, whiting, fill (1977), porcelain (1977), roofing granules, sulfur removal from stack gases, other miscellaneous uses, and uses indicated by symbol W.

[5] Data may not add to totals shown because of independent rounding.

Sulfur.—Elemental sulfur was recovered as a byproduct of petroleum refining by Standard Oil Co. of Ohio at its Lima refinery in Allen County; by Gulf Oil Co. and Sun Co., Inc., at their Toledo refineries in Lucas County; and by Ashland Oil Inc. at its Canton refinery in Stark County. The four refineries reported a combined production of 23,000 metric tons in each of the 2 years. The value of this production was $920,000 in 1978 and $905,000 in 1979.

Vermiculite (Exfoliated).—The Cleveland Gypsum Co., Division of Cleveland Builders Supply Co. in Cleveland and the O. M. Scott & Sons Co., in Marysville expanded crude vermiculite mined in the Western United States. The expanded vermiculite was used primarily as a fertilizer carrier and in loose-fill insulation, block insulation, horticulture, and soil conditioning.

METALS

Aluminum.—Primary aluminum was produced by the Ormet Corp. at its Hannibal reduction plant from alumina produced and shipped from the company-owned plant at Burnside, La. Aluminum output and value increased in both 1978 and 1979.

In 1979, Noranda Aluminum, Inc., the U.S. subsidiary of Noranda Mines, moved its headquarters to Cleveland from New Madrid, Mo., where the company's only aluminum smelter is located.

Beryllium.—Cleveland-based Brush Wellman, Inc., produced beryllium metal, alloy, oxide, and compounds from beryllium hydroxide received from the company's mine and processing facility near Delta, Utah. The Ohio plant, located at Elmore in Ottawa County, also produced shapes from beryllium metal and alloys, and ceramics for electrical applications from beryllium oxide.

Ferroalloys.—Ohio continued to be the leading producer of ferroalloys, accounting for about one-third of the Nation's total output. Combined shipments for 1978-79 totaled over 1 million short tons valued at more than $850 million. Six companies operating nine plants in Ashtabula, Guernsey, Jefferson, Monroe, Muskingum, and Washington Counties produced alloys of iron, chromium, manganese, silicon, and vanadium.

Iron Oxide Pigments.—Synthetic red iron oxide pigments were manufactured by the Ottawa Chemical Div., Ferro Corp., at its plant in Lucas County. Hilton Davis Chemicals Div., Sterling Drug, Inc., produced synthetic yellow iron oxide pigment in Hamilton County. The State's total output of pigments increased in 1978, but decreased slightly in 1979.

Iron and Steel.—Production of pig iron amounted to 14.3 million short tons in 1978 and 14.1 million short tons in 1979, decreasing for the third consecutive year. Value of the State's pig iron production in 1978 and 1979 was $2.7 and $2.8 billion, respectively; average value per short ton was $192 in 1978 and $199 in 1979.

All the ore processed in the State was imported from either domestic or foreign sources. In 1978, 38 blast furnaces were operated, employing approximately 87,000 people, with an annual payroll of over $1.7 billion.

Steel production in 1978 was 21.3 million short tons, or approximately 200,000 short tons below the 1977 level. Production in 1979 was about the same as in 1978.

Republic Steel Corp. began a $450 million modernization program to increase the blast furnace capacity of its Trumbull Cliffs plant in Warren by about 500 short tons per day. Two 200-ton electric furnaces and a $100 million byproduct coke battery were scheduled to be installed. Also planned was a $3.4 million controlled-atmosphere annealing furnace at the Union Drawn Div. in Massillon, Ohio, which was expected to increase the production capacity of annealed cold-finished steel bars by 700 short tons per month. A new $200 million bar mill was planned for Canton to replace two older mills at Massillon. The new mill would produce alloy, stainless, special metal, and carbon steel bars in various sizes.

Titanium.—RMI Co. continued to produce titanium sponge from Australian rutile at its reduction facility in Ashtabula. Some titanium sponge was sold on the open market; the remainder was shipped to the company's plant at Niles, Ohio, for further processing into finished titanium and titanium alloy mill products. In 1979, the company began a $3.5 million expansion program at its Ashtabula plant. Scheduled for completion in 1980, the expansion is expected to create 75 new jobs and increase the payroll by $2.5 million annually.

The Titanium Metals Corp. of America produced rolled and fabricated titanium products at the company's plant in Toronto, Jefferson County. The primary titanium metal was shipped from Henderson, Nev.

Zinc.—Zinc oxide was produced by ASARCO Incorporated at the company's Franklin County plant in Columbus. Zinc oxide, produced directly from ore concentrates, was used primarily in the manufacture of rubber, paints, ceramics, and in various chemical applications.

Zirconium.—Seven companies produced zirconia, zirconium alloys, refractory cores and molds, and zirconium ceramics. End uses included ceramics-base colors, foundry and ceramic industry applications, castings of high-temperature alloys, and zircon-based welding rod coatings.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Columbia Cement Corp	Box 1531 Zanesville, OH 43701	Plant	Muskingum.
General Portland Inc.[1,2]	Box 109 Paulding, OH 45879	do	Paulding.
Marquette Cement Co.[2]	Box 8 Pedro, OH 45659	do	Lawrence.
Medusa Corp.[1,2,3]	Box 5668 Cleveland, OH 44101	do	Lucas.
Southwestern Portland Cement Co.[1,2]	Box 191 Fairborn, OH 45324	do	Greene.
Clays:			
Belden Brick Co	Box 910 Canton, OH 44701	Pits	Tuscarawas.
Hydraulic Press Brick Co	Box 7786 Independence, OH 44131	do	Cuyahoga.
Kimble Coal Co	R.D. 1 Dover, OH 44622	do	Tuscarawas.
L&M Mineral Co	Star Route Millersburg, OH 44654	do	Do.
Ferroalloys:			
Foote Mineral Co	Route 100 Exton, PA 19341	Plants	Guernsey and Jefferson.
Interlake Steel Corp	135th & Perry Aves. Chicago, IL 60604	do	Washington.
Union Carbide Corp.[4]	Box 176 Marietta, OH 45750	do	Astabula and Washington.
Graphite, synthetic:			
Ohio Carbon Co	12508 Berca Rd. Cleveland, OH 44111	do	Cuyahoga.
Gypsum:			
Celotex Corp.[5]	1500 North Dale Mabry Tampa, FL 33607	Pit	Ottawa.
National Gypsum Co.[4,5]	4100 First International Bldg. Dallas, TX 75270	Plant	Lorain.
United States Gypsum Co.[1,4,5]	101 South Wacker Dr. Chicago, IL 60606	Underground mine.	Ottawa.
Lime:			
Basic, Inc	Maple Grove Fortoria, OH 44830	Plant	Seneca.
Huron Lime Co	Box 428 Huron, OH 44839	do	Erie.
Martin Marietta Chemicals	Executive Plaza II Hunt Valley, MD 21030	do	Sandusky.
Pfizer, Inc	Box 46 Gibsonburg, OH 43431	do	Do.
Republic Steel Corp	Box 6778 Cleveland, OH 44101	do	Lake.
Woodville Lime & Chemical Corp	Box 218 Woodville, OH 43469	do	Sandusky.
Peat:			
Buckeye Peat Moss	R.D. 1 Bellefontaine, OH 43311	Bog	Logan.
Perlite, expanded:			
Cleveland Builders Supply Co.[6]	2100 West 3d St. Cleveland, OH 44113	Plant	Cuyahoga.
Salt:			
Diamond Crystal Salt Co.	916 South Riverside St. Clair, MI 48079	do	Summit.
International Salt Co	Clarks Summit, PA 18411	Underground mine.	Cuyahoga.
Morton International, Inc	110 North Wacker Dr. Chicago, IL 60606	do	Lake and Wayne.
PPG Industries, Inc	Box 31 Barberton, OH 44203	Plant	Summit.
Sand and gravel:			
American Aggregates Corp.[1]	Garst Ave. Greenville, OH 45331	Pits	Various.
Dravo Corp	5254 Wooster Rd. Cincinnati, OH 45226	do	Butler, Hamilton, Warren.
Moraine Materials Co	4714 Oxford State Rd. Middletown, OH 45042	do	
Twin Lakes Sand Co	2307 State Route 303 Streetsboro, OH 44240	do	Portage.
Stone:			
Carbon Limestone Co.	Route 224 Lowellville, OH 44436	Quarries	Mahoning.
Davon, Inc	2152 Tremont Center Columbus, OH 43221	do	Adams and Highland.
France Stone Co.	1800 Toledo Trust Bldg. Toledo, OH 43604	do	Lucas, Sandusky, Seneca.

See footnotes at end of table.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Maumee Stone Co	Box 369 Maumee, OH 43537	Quarries	Lucas, Ottawa, Paulding, Wood.
National Lime & Stone Co.[4]	First National Bank Bldg. Findlay, OH 45840	do	Various.
Standard Slag Co	1200 Stambaugh Bldg. Youngstown, OH 44501	do	Ottawa.

[1] Also stone.
[2] Also clays.
[3] Also sand and gravel.
[4] Also lime.
[5] Also expanded perlite.
[6] Also exfoliated vermiculite.

The Mineral Industry of Oklahoma

This chapter has been prepared by the Bureau of Mines, U.S. Department of the Interior, and the Oklahoma Geological Survey under a Memorandum of Understanding for collecting information on all nonfuel minerals

By Robert H. Arndt[1] and K. S. Johnson[2]

Output of the principal nonfuel minerals in Oklahoma continued to rise through the 1978-79 biennium, and for the first time the nonfuels reached a total annual value of more than $200 million. The value of produced basic construction materials; sand and gravel, stone, and cement, exceeded 75% of the total nonfuel mineral value. Most of Oklahoma's economic indicators also continued to rise through the biennium, although a downturn in construction of residential units and employment in agriculture and contract construction in 1979, as reported by the Center for Economic and Management Research at The University of Oklahoma, was the main exception. The value of produced nonfuel minerals in 1978 was about 0.9% of the State's estimated gross product that year. No metallic minerals were mined in Oklahoma in the biennium. Smelting, refining, and recycling activities led to the recovery of aluminum, boron, cadmium, columbium, copper, gallium, germanium, iron, lead, magnesium, tantalum, vanadium pentoxide, and zinc.

Table 1.—Nonfuel mineral production in Oklahoma[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays ____________ thousand short tons__	1,016	$1,687	1,019	$1,874	949	$1,999
Gypsum ____________________do____	1,238	6,959	1,398	8,007	999	5,668
Helium:						
High purity ________ million cubic feet__	389	11,507	418	11,771	388	10,801
Crude____________________do____	W	W	68	822	109	1,307
Pumice__________ thousand short tons__	1	W	1	W	1	W
Sand and gravel ________________do____	11,669	26,827	[2]10,846	[2]19,056	12,101	32,502
Stone:						
Crushed ____________________do____	23,323	46,809	26,649	57,173	28,312	66,666
Dimension__________________do____	9	634	24	902	38	1,383
Combined value of cement, feldspar, iodine, lead (1977), lime, salt, sand and gravel (industrial, 1978), tripoli, zinc (1977), and items indicated by symbol W________	XX	68,217	XX	85,008	XX	80,696
Total________________________	XX	162,640	XX	184,707	XX	201,022

W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Oklahoma, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Adair	$21	W	Sand and gravel.
Alfalfa	--	W	Do.
Atoka	W	$1,680	Stone, sand and gravel.
Beaver	W	W	Sand and gravel, pumice.
Blaine	W	W	Gypsum, sand and gravel.
Bryan	W	W	Stone, sand and gravel.
Caddo	W	1,035	Gypsum.
Canadian	W	W	Sand and gravel, clays, gypsum.
Carter	66	--	
Cherokee	W	W	Stone.
Choctaw	W	W	Stone, sand and gravel.
Cimarron	W	12,593	Helium.
Cleveland	476	393	Sand and gravel.
Coal	W	W	Stone.
Comanche	W	W	Stone, gypsum.
Cotton	775	1,171	Sand and gravel.
Craig	523	577	Stone.
Creek	W	W	Stone, clays, sand and gravel.
Custer	W	W	Sand and gravel, clays.
Garfield	W	W	Sand and gravel.
Garvin	W	W	Do.
Greer	W	W	Stone, clays, sand and gravel.
Harmon	W	W	Salt.
Haskell	--	--	
Hughes	--	W	Sand and gravel.
Jackson	W	W	Gypsum.
Johnston	W	W	Stone, sand and gravel.
Kay	W	W	Do.
Kingfisher	W	W	Sand and gravel.
Kiowa	W	3,786	Stone.
Latimer	W	1	Sand and gravel.
Le Flore	W	380	Stone, sand and gravel, clays.
Logan	W	W	Sand and gravel.
McClain	725	1,136	Sand and gravel.
McCurtain	W	W	Sand and gravel, stone.
McIntosh	W	933	Stone.
Major	--	W	Sand and gravel.
Mayes	19,567	W	Cement, stone, clays, sand and gravel.
Murray	W	W	Stone, sand and gravel.
Muskogee	W	W	Sand and gravel, feldspar, stone.
Nowata	W	W	Stone.
Oklahoma	3,509	3,419	Sand and gravel, clays.
Okmulgee	W	W	Stone.
Osage	W	W	Do.
Ottawa	W	W	Stone, sand and gravel, tripoli.
Pawnee	W	W	Stone, sand and gravel.
Payne	566	908	Sand and gravel, stone.
Pittsburg	W	W	Stone, sand and gravel.
Pontotoc	26,402	W	Cement, stone, clays, sand and gravel.
Pottawatomie	W	317	Sand and gravel.
Pushmataha	W	240	Do.
Rogers	W	W	Cement, stone, clays.
Seminole	W	W	Stone, sand and gravel, clays.
Sequoyah	W	W	Lime, stone, sand and gravel.
Texas	W	W	Sand and gravel.
Tillman	350	350	Do.
Tulsa	W	W	Stone, sand and gravel, clays.
Wagoner	355	357	Sand and gravel.
Washington	W	680	Stone.
Woods	W	W	Salt.
Woodward	W	W	Iodine, sand and gravel.
Undistributed[2]	109,306	154,750	
Total[3]	162,640	184,707	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Beckham, Delaware, Dewey, Ellis, Grady, Grant, Harper, Haskell, Jefferson, Lincoln, Love, Marshall, Noble, Okfuskee, Roger Hills, Stephens, and Washita Counties are not listed because no nonfuel mineral production was reported.

[2] Includes some sand and gravel that cannot be assigned to specific counties and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Oklahoma business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	1,227.0	1,244.0	1,278.0	+2.7
Unemployment do	61.0	48.0	44.0	-8.3
Employment (nonagricultural):				
Mining[1] do	48.9	54.9	60.3	+9.8
Manufacturing do	163.0	172.4	183.3	+6.3
Contract construction do	49.5	57.3	59.8	+4.4
Transportation and public utilities do	59.3	62.7	65.2	+4.0
Wholesale and retail trade do	232.0	248.9	257.5	+3.5
Finance, insurance, real estate do	48.5	50.8	53.6	+5.5
Services do	157.9	170.1	183.8	+8.1
Government do	212.4	218.4	225.8	+3.4
Total nonagricultural employment[1] do	971.5	1,035.5	1,089.3	+5.2
Personal income:				
Total millions	$18,050	$20,526	$23,791	+15.9
Per capita	$6,407	$7,127	$8,226	+15.4
Construction activity:				
Number of private and public residential units authorized	21,256	[2]21,166	18,343	-13.3
Value of nonresidential construction millions	$414.5	$533.7	$482.8	-9.5
Value of State road contract awards do	$85.0	$160.0	$107.0	-33.1
Shipments of portland and masonry cement to and within the State thousand short tons	1,665	1,739	1,768	+1.7
Nonfuel mineral production value:				
Total crude mineral value millions	$162.6	$184.7	$201.0	+8.8
Value per capita, resident population	$58	$64	$70	+9.4
Value per square mile	$2,326	$2,641	$2,875	+8.9

[p] Preliminary.

[1] Includes bituminous coal and oil and gas extraction.

[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Free Public Library, Newark, N. J.

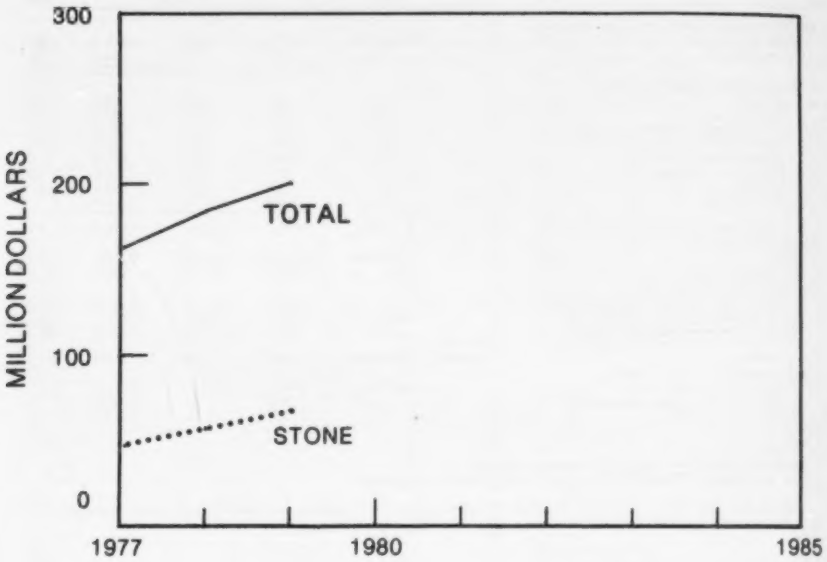

Figure 1.—Value of stone and total value of nonfuel mineral production in Oklahoma.

Mining permits are issued annually in Oklahoma by the Oklahoma Department of Mines. Thus, the number of permits issued and the number of acres of mined land held under bond for reclamation are an index of the prosperity of the mining industries. The Oklahoma Department of Mines received 256 applications for permits to mine nonfuel minerals in 1978 and 283 in 1979. In 1978, 4,156 acres were under bond for mining nonfuel minerals. In 1979, 4,500 acres were bonded under active mining permits. Based on statistics of the Oklahoma Unemployment Security Commission, average monthly employment in mining industries other than those for oil and gas was about 2,700 in 1978 and 3,300 in 1979. About one-half mined coal, and the remainder worked in nonfuel mines.

Legislation and Government Programs.—Laws enacted by the Oklahoma Legislature in 1978-79 generally supported the creation of a State program to regulate surface mining of coal and reclamation of the mined lands under requirements of Public Law 95-87, which is administered by the Office of Surface Mining (OSM) of the U.S. Department of the Interior. The 1978 Legislature also passed House Bill 1526, which reestablished the Ottawa Reclamation Authority, a local organization formed to promote the reclamation of lands affected by zinc mining in Ottawa County. House Bill 1223 related to the certification of competency of certain mine officials, defined their responsibilities, identified safe physical and operating conditions in surface mines, and listed safety procedures required for operation of equipment. Senate Bill 531 strengthened the requirements for membership on, and the operation of, the State Mining Board. House Bill 1463 dealt with qualifications for mine inspectors, their responsibilities, and reimbursement. House Bill 1690 enabled the Department of Mines to refuse to issue mining permits to mine operators who violate the mining laws of the State. Senate Bill 514 dealt with transportation of industrial wastes and their controlled disposal. The Senate sought to screen junk yards near highways from public view in Senate Bill 413. A bill relating to the control, transportation, and apportioning of water resources throughout the State was defeated in the Legislature in 1978. Subsequently in 1979, the Legislature passed Senate Bill 215, which provided procedures for funding local water storage projects. House Bill 1460, which dealt with the functions of long-range planning for water in Oklahoma remained in conference committee for renewed consideration in the 1980 session of the State Legislature. By means of House Bill 1178, the 1979 Legislature rescinded automatic consent to condemnation procedures required for Federal projects and provided that future Federal condemnation of State land be submitted to the Legislature for approval.

Results of a study of waters in the abandoned zinc mines of the Picher area were publicized by the U.S. Geological Survey, Water Resources Division, in 1978. By the study, which was cooperative with the Oklahoma Geological Survey, the mine waters were determined to be unfit for municipal and industrial purposes, and because of the highly variable pH and metal content, they could not be pumped and spilled at the surface under existing Environmental Protection Agency (EPA) water quality regulations. Zinc, cadmium, and copper are prominent dissolved metals. The survey also showed that the mine waters had a rate of rise sufficiently rapid to fill the mines within a period of 14 months, after which they could be expected to spill into the adjacent groundwater system and into the surface streams of the area around the abandoned mines. The Oklahoma Water Resources Board (OWRB) accepted responsibility for action to offset the threat to quality of existing surface and groundwater resources. By late 1979 the mines had filled, and contaminated water was spilling into the groundwater system, surfacing in Tar Creek where it passed through the mining area, and depositing iron oxide on the bottom and the banks of the stream and its tributaries. Mine water visibly flowed from mine openings at various places. Identification of a course of corrective action based on the observations of the OWRB was left to 1980. An associated problem is the possible contamination of waters in the Roubidoux Formation, underlying the abandoned mines at depth. The Roubidoux contains artesian water used by municipalities throughout northeastern Oklahoma. Authorities feared that contamination would take place by migration of mine waters downward into the Roubidoux through unplugged drill holes.

Opinions issued by the State Attorney General during the biennium created potential difficulties for the mineral industries. Traditionally, no taxes are paid on lands held by public trusts. To attract industry to Oklahoma, trusts have granted new industrial tenants use of the land on a tax-free basis and have accepted contributions in lieu of taxes. These payments have been distributed to government agencies such as school systems in the area of the trust lands. Based on interrelated opinions that the Legislature cannot pass laws to exempt any property from taxation and that State agencies have no authority to delegate to a public trust the power to collect and distribute taxes, the Attorney General ruled the practice unconstitutional. Three major brick manufacturers, a gypsum producer, and a gypsum-products producer were operating in Oklahoma on trust lands at the time the opinion was given. The Attorney General also ruled that a clause in the State Constitution prohibiting ownership of land or property by nonresident alien persons applies to corporations as well as individuals. At least 45 foreign corporations owned property directly or indirectly in fuels, manufacturing, business, and financial industries in 1979. Adherence to the Attorney General's interpretation would require foreign firms to divest themselves of their holdings, which otherwise would revert to the State. Both opinions stirred considerable resistance among financial interests and precipitated court action for relief. The questions had not been resolved at yearend.

Activities of the Oklahoma Department of Mines focused principally on furthering health and safety conditions for miners, strengthening its organization and the State Mining Board, and preparing to assume administration of the Federal program for surface mining regulations and reclamation under a State plan acceptable to the OSM. Other responsibilities of the Department of Mines included the granting of permits for all types of mining, enforcement of the State's reclamation and mine safety laws, collecting the statistics on quantities of mineral material mined, and levying and collecting a tax on mined coal. One of the unfulfilled objectives of the Department of Mines has been to focus public attention on the dangers of surface subsidence over abandoned zinc mines in Ottawa County and to provide some type of protection for the users of the surface including Federal highways and municipalities built over the abandoned mines. The cause was furthered in 1979 by U.S. Representative Mike Synar from Oklahoma's second district and Representatives Whittaker and Taylor from adjacent districts in Kansas and Missouri. The Congressmen turned to the U.S. Bureau of Mines for assistance in addressing the problems of the Tri-State zinc-mining district.

Activities of the Oklahoma Geological Survey covered a wide range of problems, studies, and services. In cooperation with the U.S. Geological Survey Water Resources Division, reports were prepared on the water resources of the Enid, Woodward, and McAlester-Texarkana quadrangles. Understandably, the Oklahoma Geological Survey's efforts were mainly focused on mineral fuels. In the nonfuel sector, however, an inventory of all past and present surface mining activity exclusive of coal was funded in part by the U.S. Geological Survey, and a compilation of data on all active mines in the western half of the State was sponsored by the Bureau of Mines Mineral Industry Location System (MILS). Continuing studies of copper anomalies throughout the State supported compilation of maps of the Southwest Davis zinc field in Murray County and of mines and prospects in McCurtain County and adjacent areas. The Oklahoma Geological Survey also assumed management and operation of the Oklahoma Geophysical Observatory at Leonard near Tulsa. Stratigraphic studies in Alfalfa, Marshall, and Washita Counties neared completion. Other stratigraphic studies coordinated with work of the Committee for Correlation of Stratigraphic Units of North America (COSUNA), funded by the U.S. Geological Survey. The Oklahoma Geological Survey also supported a continuing program of geological mapping of the Wichita Mountains by investigators from the University of Texas at Arlington, Rice University and Virginia Polytechnic Institute and State University. Water studies by the Survey made in cooperation with the U.S. Geological Survey, Water Resources Division, investigated the Antlers Sandstone, Arbuckle Limestone, Vamoosa aquifer, and baseline supply and quality of water in certain areas of eastern Oklahoma. Thirteen new publications and 19 reprints of old publications were issued by the Oklahoma Geological Survey during the biennium. Among these was a list of publications of The Oklahoma Geological Survey from 1902 to 1978.

Federal programs related to minerals and mineral production in Oklahoma issued from the Bureau of Land Management; the Bureau of Mines; the U.S. Geological Survey; the Office of Surface Mining; the Department of Agriculture, Soil Conservation Service; the U.S. Army Corps of Engineers; and the Department of Labor, Mine Safety and Health Administration. Management of the Bureau of Mines plant for extracting helium from natural gas at Keyes in Cimarron County, growing involvement in the problems of surface stability over the abandoned mines of the Tri-State zinc-mining district, and sponsorship of contractual research relating to minerals and mining problems were activities of the Bureau of Mines. The Bureau of Mines committed itself to the Congressional Representatives of Oklahoma's northeast district and adjacent districts in Kansas and Missouri for an evaluation of hazards involved in using potentially unstable land above the abandoned and water filled zinc mines of that area. Research treating the control of methane in gob areas, reduction of pollutants from engines operated in underground mines, control of radiation from tailings in the backfill areas of uranium mines, operations and equipment related to the boring of a 96-inch shaft in the Piceance Creek basin of Colorado, effluents from an aluminum miniplant, development of various electronic, seismic, and X-ray equipment, drilling services in mineral exploration, and compilation of mine locations for the Bureau of Mines MILS project was contracted to various industrial, commercial, and academic research groups in Oklahoma. The Bureau's liaison office in Oklahoma City was closed in September 1979 as part of an agency-wide reorganization.

Bureau of Mines research regarding the use of internal-combustion engines in underground mining continued on a contractual basis at the Bartlesville Energy Technology Center of the U.S. Department of Energy.

The U.S. Geological Survey maintained offices in Tulsa and Oklahoma City, with an area mining supervisor and an area geologist in Tulsa. These offices were concerned with the regulation of operations for prospecting, developing, and production of fuel and other minerals on leased Federal and Indian lands. Concerns of the geologist's office included the classification of lands, minerals, and other related natural resources, with an inventory of mineral resource data relating to leasable minerals, and with the collection and interpretation of geologic data to support management of Federal mineral holdings and Federal lands. The Water Resources Division was engaged in cooperative studies with the Oklahoma Geological Survey in compilation of information for the series of Oklahoma Hydrologic Atlases. Major undertakings relating to mining were the establishment of baseline hydrologic conditions in the surface and subsurface of eastern Oklahoma and a specific study to identify the quantity and quality of the waters that have flooded abandoned zinc mines in Ottawa County.

The Mine Health and Safety Administration (MSHA) of the U.S. Department of Labor succeeded the Mining Enforcement and Safety Administration (MESA) of the U.S. Department of the Interior as the the Federal agency to control safety and health in mining operations. MSHA maintained an office in McAlester and a metal and nonmetal mine inspection office in Norman.

Transportation.—More than 3.6 million tons of cargo was carried on the McClellan-Kerr Arkansas River Navigation System during 1979, according to preliminary statistics of the U.S. Army Corps of Engineers. Mineral commodities (including fuels) and first generation derivatives of mineral materials provided 2,016,602 tons, or 55.7% of the total tonnage. Mineral cargo carried in 1978 was approximately 2.1 million tons.

About 700 miles of railroad trackage in Oklahoma had been approved for abandonment or was being considered for future abandonment in 1978. A salt producer in Woods County would be isolated by the abandonments. Traffic on a section of rail line that serves the Universal Atlas Cement Co. gypsum mine in Blaine County was being compared with traffic on other parts of the line. The financial dilemma of the Chicago-Rock Island and Pacific Railroad threatened interruption of through service from east to west and from north to south in Oklahoma. Crushed stone from operations in the vicinity of the Wichita Mountains was being rail-shipped interstate and intrastate in large quantities on the north-south line. The stone was shipped to Oklahoma City and throughout western and northwestern Oklahoma.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—After suffering disruption caused by installation of coal-burning apparatus in 1976-77, the cement industry returned essentially to its practical production capacity in 1978. Plants of the Ideal Cement Co., Division of Ideal Basic Industries, at Ada; Martin Marietta Corp. at Tulsa; and the OKC Corp. at Pryor produced portland and masonry cement of both white and gray varieties classified as general-purpose-moderate heat, high-early-strength, very-high-sulfate-resistance, oil-well, waterproof portland, and other varieties. General-purpose-moderate-heat provided more than 95% of the value of total cement produced. Cement manufacture consumed about 10% of the State's limestone output, about 40% of clay and shale produced in the State, and used additional smaller quantities of bauxite, sand, iron ore, and gypsum, as well as numerous chemical additives. The industry operated both dry process kilns equipped with glass-bag collectors and wet-process kilns with electric dust precipitators. Even after converting to coal, the industry continued to use natural gas at a rate of about 1.2 billion cubic feet per year. Almost 300,000 tons of bituminous coal and more than 220 million kilowatt-hours of electric current were also used. About 90% of the cement was shipped by truck. The remainder was shipped by rail. In mid-1979, concrete haulers and intrastate cement haulers sought increases in wages and rates for bulk long distance transport of the cement. OKC Corp. expanded its Pryor plant by addition of a ball mill, a 400-foot rotary kiln, a grate clinker cooler, additional dust collectors, cement-storage silos, analog instrumentation, and a Raymond coal mill at a cost of $21 million. A test run in September 1979 preceded regular startup scheduled for early 1980. Additions to the plant would increase its annual capacity by 280,000 short tons. In July of 1979, directors of OKC Corp. of Dallas formulated a plan for sale of the firm's assets, which included the cement plant.

Clays.—Although the output of clay in the 1978-79 biennium fluctuated some from production in 1977, inflationary elements of the economy continued to increase the value of the product. Common clay and shale were mined for the manufacture of face brick, pottery, sewer pipe, portland cement, and light-weight aggregate used in concrete block and structural concrete. Source pits were in Canadian, Creek, Custer, Greer, Le Flore, Mayes, Oklahoma, Pontotoc, Rogers, and Seminole Counties. Pontotoc, Rogers, and Oklahoma Counties led all the others in clay production. Significantly the cement industry was the leading user and producer of clay in Pontotoc and Rogers Counties, and the lightweight-aggregate industry provided the largest demand in Oklahoma County.

In all, 12 firms supported 15 operations. Justin Industries Acme Brick Co. manufactured brick in plants in Clinton, Edmond, and Tulsa. Chandler Materials Co. manufactured lightweight aggregate in plants in Choctaw and Tulsa. Pottery was manufactured by Frankoma Pottery Inc., in Sapulpa, clay excavated by W.S. Dickey Clay Manufacturing Co. in Le Flore County was utilized in the manufacture of sewer pipe. Other brick plants were in Union City, Wewoka, Mangum, Sapulpa, and Ada. Most clay products had a statewide distribution. Some had a regional or national distribution. Several plants shipped brick to distant markets by rail but most utilized trucks for local or subregional transport. Expansion of clay plants was noteworthy. Chandler Materials Co. installed a new 175-foot-long kiln at its Tulsa plant to replace four smaller, less efficient kilns and to reduce its total fuel consumption. Acme Brick Co. completed a 50-million-brick-per-year plant at Edmond, and for $1 million purchased the former plant of United Clay Pipe Co. in Seminole with most of the plant equipment and 100 acres of land. Oklahoma Brick Corp. announced plans to construct a plant with a capacity of about 55 million brick per year near Mounds in southern Creek County but abandoned that site after disagreement with landowners over the definition of mineral rights and the use of surface clays for the plant. An alternate site was selected near Muskogee. In November 1979, International American Ceramics Inc., a firm sponsored by American, Italian, and Mexican investors, revealed plans to construct a plant with a capacity to manufacture about 20 million square feet of glazed ceramic flooring tile annually in the new Cherokee Expressway Industrial district north of Tulsa. Clay of proper quality would be obtained from unspecified clay deposits situated within 10 miles of the plant.

Feldspar.—Ashland Oil Co.—Arkhola Sand and Gravel Co. at Muskogee dredged sand from the bed of the Arkansas River. Processing converted this sand to a product that contained 75% quartz and 25% feldspar. At least three glass plants in Oklahoma utilized the sand for its feldspar content rather than obtaining feldspar from other distant sources. Irregular size of the quartz grains in the river sands apparently led to some increases in furnace costs and some deficiencies in the quality of the glass produced. However, several Oklahoma glass manufacturers minimized these difficulties in the preparation of glass for containers.

Gypsum.—By value of product Oklahoma ranked fifth among gypsum producing States in 1978. More than half of the State's output was obtained from mines of United States Gypsum Co. and Universal Atlas Cement Div. of United States Steel Corp. in Blaine County. Other counties in which gypsum was mined were, in order of decreasing output: Comanche, Jackson, Caddo, and Canadian. Gypsum was obtained from the Blaine Formation and the Cloud Chief Formation of Permian age, which are exposed in almost continuous belts of outcrop from the Kansas border on the north to the Texas border in southwestern Oklahoma. Gypsum mined by United States Steel Corp. at Watonga in Blaine County was shipped out of State for use as a retarder in manufacture of cement by Universal Atlas Cement Co. Much of United States Gypsum's product was calcined at a plant at Southard in Blaine County and converted to gypsum board and plaster. Because of exceptionally high quality the gypsum was also used extensively in special products, such as fillers, and extenders in food products and paints. Temple Gypsum mined gypsum at Fletcher and shipped it to a calcining and wallboard plant in West Memphis, Ark. Republic Gypsum Co. mined and calcined its gypsum near Duke in Jackson County. Raw gypsum was used in soil treatment in Oklahoma. A new surface mine for the extraction of gypsum was reported to have been opened near Quinlan in Woodward County in 1979. The product was crushed to a gravel size and sold to surface rural roads in Woodward County.

Iodine.—The Nation's largest iodine producer, Woodward Iodine Operations, a joint project of PPG Industries, Inc., and Amoco Production Co, strove to raise production to plant capacity of 2 million pounds of iodine per year. The plant, north of Woodward in Woodward County, utilized 14 wells to extract brine from Morrowan (Pennsylvanian) strata at a depth of 7,000 to 7,500 feet and to return stripped brine to the subsurface by reinjection. The operation was hindered by the concurrent production of sour natural gas, a salable product. Some controversy arose between the firm and the owners of mineral rights on adjacent properties, who contended that the reinjection of spent brines tended to isolate iodine-bearing brines in their holdings or to flush such brines from beneath the acreage of their mineral rights, thus depriving them of mineral assets and potential mineral production.

Lime.—Lime production increased in Oklahoma during the biennium as a result of plant expansion by St. Clair Lime Co. at Marble City. New facilities for crushing, screening, air separating, and drying finely ground limestone made it possible to increase output of lime by as much as 50%. The firm also completed installation of dust-control equipment required to meet air-quality standards. Residents in the vicinity of the Marble City plant earlier had brought suit against the company on complaints of air and water pollution and damage to property from airborne lime dust. This suit was settled out of court.

Pumice (Volcanic Ash).—Axtell Mining Corp. continued mining volcanic ash at its pit near Gate in Beaver County. The total value of the mined ash continued to rise during the 2-year period. The deposit, largely shards of volcanic glass mixed with feldspar, clay, quartz, mica, and diatom fossils, is one of numerous small deposits of this nature found in western and northern Oklahoma but is the only one mined. Ground ash is used in making soft abrasives and other unspecified products. Historically, production has decreased as other abrasives have been substituted for the ash by manufacturers of scouring powders.

Salt.—Acme Salt Co. in Harmon County and Blackmon Salt Co. in Woods County produced both salt brine and crystal salt evaporated from brine in solar pans. Natural brines that originate in underground salt beds in the Flowerpot Shale of Permian age emerge at the surface as springs at both sites and also are pumped from shallow wells drilled into brine-filled solution cavities in the salt beds. Crystal salt was used to rejuvenate zeolites in water softeners, as a stockfeed, and in deicing winter roads. As a result of the corrosive characteristics of salt on pavements the Oklahoma City city council abandoned use of salt as a deicing agent in 1978. As the following winter season progressed and no suitable substitute had been found, the city returned to frugal use of its relatively small salt supply. By midwinter of 1978-79, Oklahoma City, Tulsa, and other Oklahoma communities experienced shortages of salt; sand, the most common substitute, proved to be inadequate for deicing by itself. The communities of Yukon and Mustang in central Oklahoma successfully deiced their streets by spraying them with brine pumped from oil wells. Because State law prohibits the dumping of oilfield brines on the surface, the Oklahoma Legislature took special action to legalize the emergency use of brines for street and highway deicing.

Sand and Gravel.—Sand and gravel ranked second among mineral materials produced in Oklahoma in 1978-79 in respect to quantity mined and third in value of the product. The output of sand and gravel from Tulsa, Oklahoma, Cotton, and McClain Counties made up more than 50% of the State's total production. Regionally, the State's metropolitan centers, where construction abounds, also weighed heavily in sand and gravel production. Tulsa County was the source of more than one-fourth of the State total and the Oklahoma City area, deriving its sand and gravel from deposits in Oklahoma, McClain, Cleveland, and Canadian Counties accounted for almost one-fourth of the production. In 1979, 124 firms held State permits to mine sand. The permits identified 138 sand pits distributed among 37 counties. Actually only 97 pits were used by the 86 firms that reported production to the State. About 450 persons were employed in mining sand and gravel.

Principal sources of sand and gravel in most parts of the State were stream beds and flood plains of existing streams, particularly the Arkansas River near Tulsa, the North Canadian River, the Canadian River, and the Cimarron River near Oklahoma

City, and the Red River in the southwestern part of the State. Stream terrace deposits and upland sand and gravel deposits were used extensively locally. Friable, high-purity silica sand in the Simpson Group of Ordovician age provided much industrial sand for Pennsylvania Glass Sand Corp. in Johnston County and for Midcontinent Glass Sand Corp. in Pontotoc County.

More than 95% of all the sand and gravel produced was used as construction material; the remainder was used for industrial purposes. Almost half of the industrial sand and gravel was used in the manufacture of glass containers. Flat glass and speciality glass required additional appreciable quantities. Ashland Oil Co.-Arkhola Sand and Gravel Co. prepared a mixture of beneficiated river-run sand containing 25% feldspar for use in the glass-making industry in Oklahoma. The product was used particulary in manufacturing bottles, jars, and other containers. Related uses were in the manufacture of refractories, pottery, porcelain, and tile. Silica sand was sold for use in making foundry molds and cores, and a large quantity was used as abrasive material. Other uses of industrial sands were as roofing granules, support media in hydraulic fracturing of geologic formations, filtration media, and fillers. A high level of building construction in Oklahoma in 1978 supported the aggregate industry. Building permits for construction valued at $424 million that year ranked Tulsa 11th in the Nation, according to Dunn and Bradstreet, Inc. Oklahoma City ranked 16th but witnessed a decline in the value of permits from the year before.

Brandt Equipment and Supply Co. undertook construction of a plant near Roff in Pontotoc County to prepare resin-coated silica sand for use in the steel casting industry. Projected plant output was 3,500 to 4,000 tons of sand per month, using sand from the State's principal silica sand mines nearby in Pontotoc and Johnston Counties.

More than 80% of the sand and gravel was transported by truck. The rapid increase in the cost of fuel posed considerable problems for truckers of sand and gravel and other aggregate materials in 1979. The problem was aggravated by an existing 14% incentive discount on trucking rates to users of aggregate materials within the State. Truckers effectively slowed the transportation of aggregate while they sought revocation of the 14% discount. Relief was first given to them by the Oklahoma Corporation Commission in the form of a rate increase automatically geared to the price of diesel fuel, later by an additional 15% increase in rates.

Payments of $8.45 million to the Cherokee Nation were not authorized by the U.S. Senate Interior Appropriations Subcommittee. These payments awarded by Federal court for sand and gravel taken from the riverbed and used in the construction of McClellan-Kerr Arkansas River Navigation System were delayed until at least 1981. A judge in Tulsa district court ruled that the Arkansas River in Oklahoma is a meandering, braided, non-navigable stream. Based on previous rulings of the U.S. and State Supreme courts applied to the Canadian and Red Rivers the boundaries of the stream were defined as the cutbanks, and mineral rights that extend from opposite banks terminate at the median between cutbanks.

Table 4.—Oklahoma: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	4,921	$10,500	$2.13	5,483	$10,983	$2.00	5,660	$12,477	$2.21
Plaster and gunite sands	NA	NA	NA	83	118	1.43	W	W	W
Concrete products	623	1,255	2.01	423	864	2.04	465	1,024	2.20
Asphaltic concrete	1,128	2,257	2.00	1,003	2,021	2.01	787	2,110	2.68
Roadbase and coverings	1,077	1,779	1.65	1,152	2,044	1.77	748	1,450	1.94
Fill	2,444	2,508	1.03	2,633	2,776	1.05	2,565	2,736	1.07
Snow and ice control	NA	NA	NA	W	W	W	W	W	W
Railroad ballast	W	W	W	--	--	--	(1)	(1)	--

See footnotes at end of table.

Table 4.—Oklahoma: Construction sand and gravel sold or used, by major use category —Continued

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Other uses	61	167	2.67	69	250	3.65	297	573	1.97
Total[2] or average	10,255	18,465	1.80	10,846	19,056	1.76	10,496	20,372	1.94

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Less than 1/2 unit.

[2] Data may not add to totals shown because of independent rounding.

Table 5.—Oklahoma: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	7,892	$13,890	$1.76	8,689	$14,645	$1.69	8,694	$18,621	$1.91
Gravel	2,362	4,575	1.94	2,157	4,411	2.04	1,801	3,751	2.08
Total or average	10,255	18,465	1.80	10,846	19,056	1.76	10,496	20,372	1.94
Industrial sand	1,414	8,362	5.91	W	W	W	1,605	12,129	7.56
Grand total[1] or average	11,669	26,827	2.30	W	W	W	12,101	32,502	2.69

W Withheld to avoid disclosing company proprietary data.

[1] Data may not add to totals shown because of independent rounding.

Stone.—The total output and value of limestone, dolomite, sandstone, and granite were greater than those of any other raw nonfuel mineral product of Oklahoma during the biennium. About 50 firms held permits for quarrying with operations in 27 counties. Stone quarried in Murray, Tulsa, Comanche, Kiowa, and Rogers Counties comprised more than half of the State's output. Limestone was the main stone quarried. All stone was obtained from open quarries except that from two underground limestone mines that operated during the biennium: St. Clair Lime Co. mined high-purity limestone during 1978-79 in Sequoyah County, and Arkhola Sand and Gravel Co. mined aggregate near Fort Gibson in Cherokee County until collapse of the roof in a part of the mine terminated operations in September of 1978. Quarrying took place mostly in the eastern half and the southwestern part of the State. Locally a large industry flourished in Tulsa and neighboring Creek and Rogers Counties to supply aggregate for urban construction. Oklahoma City's needs were satisfied from limestone quarries in the Arbuckle Mountains in southern Oklahoma and in the vicinity of the Wichita Mountains of southwestern Oklahoma. These sources also supplied construction stone for the north-central and western parts of Oklahoma. Quarries in Osage, Washington, Cherokee, and Mayes Counties provided limestone for the northeastern counties. McCurtain, Choctaw, Bryan, and Atoka Counties provided limestone for agricultural purposes and sandstone for road construction in the southeastern counties of Oklahoma and in the northeastern part of Texas. Granite was quarried in Greer, Johnston, and Kiowa Counties. Dolomite was quarried in Johnston County near Mill Creek. All types of stone were crushed. More than half of the material was used in road construction, and a significant quantity went to the manufacture of cement. The quantity of limestone that was used to prepare lime is concealed among other uses. Both local and national firms quarried granite for use essentially as monuments and markers. Dolomite was crushed for aggregate and for special metallurgical and chemical processes. Crushed hard sandstone was used as antiskid surfacing on highways.

Noteworthy quarry activities included the opening of a new openpit limestone quarry east of Fort Gibson by Arkhola Sand and Gravel Co. H. D. Youngman, contractor, installed new cone crushers at the quarry near Apple in Choctaw County to process sandstone used as road surfacing material. Anchor Stone Co. abandoned a quarry in West Tulsa because of neighbor pressure and poor quality of the stone. New crushing, screening, and conveying equipment was installed by Hallet Construction Co. at its Davis quarry. Tulsa Rock Co., conscious of environmental impact in its quarry operations near urban development, completed the first phase of placing its quarrying and processing operations below ground level in its new 600,000-ton-per-year quarry near Owasso.

Table 6.—Oklahoma: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	458	946	439	870	467	942
Concrete aggregate	[2]8,072	[r,2]18,316	7,344	17,269	7,968	20,951
Bituminous aggregate	1,727	3,741	2,404	5,473	2,152	5,582
Dense-graded roadbase stone	5,791	8,893	7,359	11,984	7,846	13,907
Surface treatment aggregate	1,819	4,951	2,321	6,955	2,797	8,464
Other construction aggregate and roadstone	746	1,191	1,043	2,066	1,426	3,216
Riprap and jetty stone	537	1,177	407	980	653	1,410
Railroad ballast	1,400	2,756	1,794	4,112	2,011	5,174
Filter stone	11	26	112	216	30	91
Cement manufacture	2,425	3,790	2,551	3,885	2,303	4,275
Fill	W	W	112	230	147	298
Other uses[3]	338	1,023	763	3,135	512	2,355
Total[4]	[r]23,323	[r]46,809	26,649	57,173	28,312	66,666

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite 1978-79, sandstone, and miscellaneous stone (1977).

[2] 1977 data include manufactured fine aggregate (stone sand).

[3] Includes stone used for poultry grit and mineral food, macadam aggregate, lime manufacture, asphalt filler, other filler (1977), manufactured fine aggregate (stone sand) (1978-79), glass manufacture (1978-79), and other uses.

[4] Data may not add to totals shown because of independent rounding.

Sulfur.—Sulfur was recovered in natural gas processing and petroleum refining operations by Pittston Co. at Madill, by the Sun Oil Co. refinery at Duncan, and by Texaco, Inc., at its West Tulsa refinery.

Tripoli.—American Tripoli Co., a division of the Carborundum Co., and Midwestern Minerals Corp. mined tripoli in Ottawa County. The tripoli was recovered from shallow lenticular deposits in the Boone Formation of the Mississippian System. Raw tripoli was processed by American Tripoli Co. in a plant in Seneca, Mo. The product was used to make very fined-grained abrasives.

METALS

No metallic ore was mined in Oklahoma in the 1978-79 biennium. However, metals were recovered in a variety of smelting operations that utilized ore concentrates and recycled materials. National Zinc Co., a division of Englehard Minerals & Chemicals Corp., recovered zinc and cadmium from zinc concentrates in its smelter at Bartlesville. Somex Ltd., a sister firm in the Englehard Minerals & Chemicals Corp., constructed an $8 million plant to extract vanadium pentoxide from ash residues of oil-burning power-generating boilers in Western Europe and the United States. This plant was constructed on the grounds of National Zinc Co. at Bartlesville. The annual output of the plant, rated at 4 million pounds of vanadium pentoxide per year, was destined for conversion to ferrovanadium in a plant in Virginia. Armco Steel Corp. recycled steel scrap from which it made steel fence posts and reinforcing bar for concrete construction. Kaiser Magnesium Co., a subsidiary of Kaiser Aluminum and Chemical Co., recovered magnesium from foreign motor-car blocks and produced magnesium ingots and anodes. Germanium and gallium metal and chemicals and boron-10 were recovered in operations of Eagle Picher Industries, Inc., at Quapaw. Fansteel Metals in Muskogee produced tantalum and columbium metal.

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[1] State mineral specialist, Bureau of Mines, Denver, Colo.

[2] Geologist, Oklahoma Geological Survey, Norman, Okla.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Ideal Basic Industries, Inc., Ideal Cement Co.[1] [2]	Box 8789 Denver, CO 80201	Quarry and plant	Pontotoc.
Martin Marietta Cement Western Div.[1] [2]	5350 East 46th St. Tulsa, OK 74135	do	Rogers.
OKC Corp. Oklahoma Cement Div. of OKC Corp. [1] [2]	Box 68 Pryor, OK 74361	do	Mayes.
Clays:			
Chandler Materials Co	Box 627 Tulsa, OK 74101	Mine and plant	Oklahoma and Rogers.
Commercial Brick Corp	Box 1382 Wewoka, OK 74884	do	Seminole.
W. S. Dickey Clay Manufacturing Co	Box 6 Pittsburg, KS 66762	Mine	Le Flore.
Frankoma Pottery, Inc	Box 789 Sapulpa, OK 74066	Mine and plant	Creek.
Justin Industries Acme Brick Co	Box 425 Fort Worth, TX 76101	do	Canadian, Custer, Oklahoma, Tulsa.
Mangum Brick Co	Box 296 Mangum, OK 73554	do	Greer.
Oklahoma Brick Corp	Box 87 Union City, OK 73090	do	Canadian.
Sapulpa Brick and Tile Co	Box 1170 Sapulpa, OK 74066	do	Creek.
Superior Clay Products, Inc	Box 1501 Ada, OK 74820	do	Pontotoc.
Feldspar:			
Ashland Oil Co.- Arkhola Sand and Gravel Co.[2] [3]	Box 1627 Fort Smith, AR 72902	Dredge and plant	Muskogee.
Gypsum:			
Harrison Gypsum Co., Inc	Box 336 Lindsay, OK 73052	Quarry	Caddo.
Republic Gypsum Co.	Box 750 Dallas, TX 75221	Quarry and plant	Jackson.
Schweitzer Gypsum Co	Route 2, Box 69 Okarche, OK 73762	Quarry	Canadian.
Temple Gypsum	Box 1270 West Memphis, AR 72301	do	Comanche.
United States Gypsum Co.	101 South Wacker Dr. Chicago, IL 60606	Quarry and plant	Blaine.
United States Steel Corp	600 Grant Str. Pittsburgh, PA 15230	Quarry	Do.
Iodine:			
PPG Industries, Inc., Woodward Iodine Operations.	Box 1245 Woodward, OK 73801	Brine field and plant.	Woodward.
Lime:			
St. Clair Lime Co	Box 569 Sallisaw, OK 74955	Plant and quarry	Sequoyah.
Pumice (volcanic ash):			
Axtell Mining Corp	Box 92 Gate, OK 73844	Open pit	Beaver.
Salt:			
Acme Salt Co	Box 420 Erick, OK 73645	Solar evaporation	Harmon.
Blackmon Salt Co	Route 1 Freedom, OK 73842	do	Woods.
Sand and gravel:			
The Dolese Co.	Box 677 Oklahoma City, OK 73101	Pit and plant	Canadian, Garfield, Kingfisher, Logan, McClain.
E & A Materials	Box 365 Wichita Falls, TX 76307	do	Cotton.
General Materials Co., Inc	Box 24044 Oklahoma City, OK 73124	do	Oklahoma.
McMichael Concrete Co.[2]	Box 9486 Tulsa, OK 74107	do	Tulsa.

See footnotes at end of table.

Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel —Continued			
Mohawk Rock and Sand Co	Box 640 Sand Springs, OK 74063	Pit and plant	Tulsa.
Pennsylvania Glass Sand Corp., Oklahoma Works.	Box 36 Mill Creek, OK 74856	do	Johnston.
Shoffner Sand of Oklahoma, Inc	Box 863 Edmond, OK 73034	do	Oklahoma.
Stone:			
Anchor Stone Co.[3]	Box 6130 Tulsa, OK 74106	Quarry	Tulsa.
Ashland Oil Co.-Standard Industries, Inc.	Box 15670, Admiral Sta. Tulsa, OK 74112	do	Kay, Osage, Tulsa.
Century Granite Co., Inc	Industrial Park Frederick, OK 73542	do	Greer and Johnston.
Delta Mining Corp	Box 85 Mill Creek, OK 74856	do	Johnston.
Dolese Bros. Co	Box 677 Oklahoma City, OK 73101	do	Atoka, Caddo, Carter, Coal, Comanche, Kiowa, Murray, Seminole.
Eagle-Picher Industries, Inc	Box 910 Miami, OK 74354	Rock waste recovery.	Ottawa.
Fairfax Granite, Inc	Box 482 Barre, VT 05641	Quarry	Comanche, Greer, Kiowa.
Hallett Construction Co	Box 13 Boone, IA 50036	do	Murray.
Idabel Stone Co	Box 934 Paris, TX 75460	do	Choctaw and McCurtain.
Lattimore Industries, Inc	Box 1186 Denison, TX 75020	do	Bryan.
Leco Materials, Inc	Drawer D, Admiral Sta. Tulsa, OK 74112	do	Rogers, Nowata, Washington.
The Quapaw Co.[1]	Box 72 Drumright, OK 74030	do	Creek.
Willis-Pellow Bros. Monument Co	Box 188 Granite, OK 73547	Quarry and plant	Greer.
H. D. Youngman, Contractor	Box 647 Eufaula, OK 74432	do	Choctaw and McIntosh.
Tripoli:			
The Carborundum Co	Box 489 Seneca, MO 64865	Pits	Ottawa.

[1] Also clays.
[2] Also stone.
[3] Also sand and gravel.

The Mineral Industry of Oregon

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Oregon Department of Geology and Mineral Industries for collecting information on all nonfuel minerals.

By George T. Krempasky,[1] Donald A. Hull,[2] and Jerry J. Gray[3]

Oregon's nonfuel mineral production was valued at $129 million in 1978 and $165 million in 1979. Nonmetals—cement, clay, diatomite, gem stones, lime, pumice, sand and gravel, stone, and talc—accounted for more than 90% of the production value for both 1978 and 1979.

During 1978, expanding construction activities resulted in increased demands for cement that could not be met by Oregon cement producers; additional supplies had to be imported from neighboring States and foreign sources. The two existing plants operated at nearly full capacity; output was considerably higher than the average of the last 5 years. By late 1979, supply and demand were again in balance because of production from a new third plant.

Metals—copper, gold, nickel, and silver—accounted for less than 10% of the nonfuel mineral production values during the 2 year period. Oregon remained the only domestic source of primary nickel; output fluctuated during 1978 because of a weak commodity market and plant repair problems. During 1979, the market became stronger and output was steady.

Trends and Developments.—Oregon's mineral and metallurgical industry is diversified and adds stability to the State's economy. The industry mined and processed nonmetallic and metallic minerals, and reduced and refined exotic metals. It operates relatively free of Federal or State subsidies, locates its own resources, develops mines and facilities with its own money, and sells products that benefit the general economy.

Exploration programs were conducted for chromium, gold, iron, mercury, molybdenum, nickel, and silver in geologically favorable environments. Demand for construction minerals—cement, pumice, crushed stone, and sand and gravel—increased and will continue to do so. In addition, areas mined for construction materials have been used for other purposes after mining ceased. For example, in the City of Bend, in central Oregon, former pumice pits are used for home construction sites and landscaped areas. The State's mined land reclamation program will continue to nurture increases in mined land rehabilitation and redevelopment.

Oregon's processing of mineral commodities to usable products is also expected to increase. Occidental Chemical Co., a subsidiary of Occidental Petroleum Corp., has begun to acquire permits necessary to build a $25 million fertilizer importing, mixing and transhipment facility at St. Helens, on the Columbia River below Portland. The plant is expected to receive up to 200,000 tons of ammonia yearly from the U.S.S.R., and an additional amount from Alaska. It will also handle large quantities of urea, potash, and other fertilizer materials.

Table 1.—Nonfuel mineral production in Oregon[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:						
Masonry thousand short tons	W	W	1	$75	W	W
Portland do	W	W	574	29,104	W	W
Clays do	119	$193	140	261	139	$263
Copper (recoverable content of ores, etc.) metric tons	5	7	W	W	2	4
Diatomite thousand short tons	3	W	W	W	W	W
Gem stones	NA	520	NA	600	NA	500
Gold troy ounces	675	100	340	66	W	W
Lead metric tons	--	--	--	--	(2)	(2)
Nickel (content of ores and concentrates) short tons	14,347	W	13,509	W	15,065	W
Pumice thousand short tons	1,083	2,429	915	2,016	781	1,644
Sand and gravel do	15,833	33,127	19,130	44,510	17,874	45,829
Silver thousand troy ounces	7	33	2	9	2	17
Stone thousand short tons	[3]17,600	[3]39,400	[3]17,685	[3]39,509	25,739	65,078
Talc and soapstone short tons	721	151	W	W	W	W
Combined value of lime, stone (dimension), tungsten concentrate (1977), and values indicated by symbol W	XX	33,172	XX	12,693	XX	51,872
Total	XX	109,132	XX	128,843	XX	165,207

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Less than 1/2 unit.

[3] Excludes dimension stone; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Oregon, by county

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Baker	$12,118	$14,469	Cement, stone, sand and gravel, clays, gold, pumice, silver, copper.
Benton	W	W	Stone, sand and gravel, clays.
Clackamas	W	W	Cement, sand and gravel, stone, clays.
Clatsop	1,289	1,380	Stone, sand and gravel.
Columbia	W	W	Sand and gravel, stone.
Coos	602	770	Stone, sand and gravel.
Crook	W	W	Sand and gravel, stone.
Curry	W	W	Stone, sand and gravel.
Deschutes	W	W	Pumice, sand and gravel, stone.
Douglas	W	W	Nickel, sand and gravel, stone.
Gilliam	W	W	Sand and gravel, stone.
Grant	W	W	Do.
Harney	225	78	Stone.
Hood River	237	505	Do.
Jackson	W	W	Sand and gravel, stone, talc.
Jefferson	37	W	Stone.
Josephine	W	W	Sand and gravel, stone.
Klamath	W	W	Stone, sand and gravel, pumice, clays.
Lake	W	W	Stone, diatomite, pumice, sand and gravel.
Lane	9,095	8,859	Sand and gravel, stone.
Lincoln	1,728	2,024	Stone, sand and gravel.
Linn	1,152	1,428	Sand and gravel, stone.
Malheur	W	W	Lime, sand and gravel, stone.
Marion	1,809	4,829	Sand and gravel, stone.
Morrow	377	302	Do.
Multnomah	W	W	Sand and gravel, lime, stone, clays.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Oregon, by county —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Polk	$521	$543	Stone, sand and gravel.
Sherman	66	69	Stone.
Tillamook	323	623	Stone, sand and gravel.
Umatilla	1,752	1,665	Do.
Union	406	607	Sand and gravel, stone.
Wallowa	117	102	Do.
Wasco	160	43	Stone.
Washington	W	8,326	Stone, sand and gravel.
Wheeler	W	W	Do.
Yamhill	1,622	1,496	Do.
Undistributed[1]	75,498	80,724	
Total[2]	109,132	128,843	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes gem stones, stone that cannot be assigned to specific counties, and values indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Oregon business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	1,131.0	1,196.0	1,217.0	+1.8
Unemployment	do	83.0	72.0	83.0	+15.3
Employment (nonagricultural):					
Mining	do	1.8	2.2	2.3	+4.5
Manufacturing	do	206.1	219.1	227.3	+3.7
Contract construction	do	42.6	48.8	53.0	+8.6
Transportation and public utilities	do	53.7	56.9	59.7	+4.9
Wholesale and retail trade	do	225.7	245.6	256.5	+4.4
Finance, insurance, real estate	do	57.6	64.2	69.0	+7.5
Services	do	162.6	175.5	183.9	+4.8
Government	do	186.8	197.1	199.3	+1.1
Total nonagricultural employment	do	936.9	1,009.4	1,051.0	+4.1
Personal income:					
Total	millions	$17,184	$19,736	$22,345	+13.2
Per capita		$7,207	$8,076	$8,842	+9.5
Construction activity:					
Number of private and public residential units authorized		39,133	[1]38,556	29,143	-24.4
Value of nonresidential construction	millions	$267.8	$444.5	$467.7	+5.2
Value of State road contract awards	do	$109.5	$84.0	$195.5	+132.7
Shipments of portland and masonry cement to and within the State	thousand short tons	842	969	977	+.8
Nonfuel mineral production value:					
Total crude mineral value	millions	$109.1	$128.8	$165.2	+28.3
Value per capita, resident population		$46	$53	$65	+22.6
Value per square mile		$1,125	$1,329	$1,703	+28.1

[p] Preliminary.

[1] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Oregon Metallurgical Corp., a major titanium producer in Albany, was reported to be studying an expansion of titanium sponge capacity to be completed in late 1980 or early 1981. The company's net sales more than doubled in the 6-month period ending March 31, 1979, compared with the same period in 1978; it expects the titanium market to remain strong through 1980.

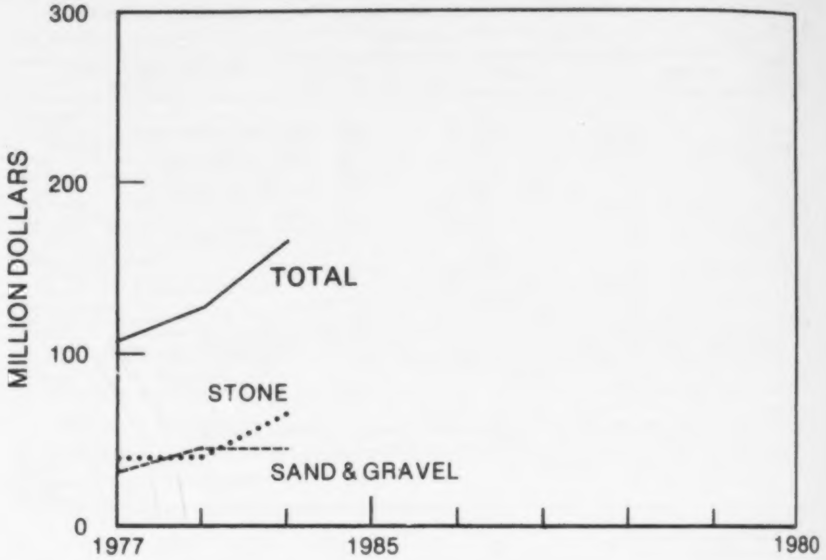

Figure 1.—Value of sand and gravel and stone, and total value of nonfuel mineral production in Oregon.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—During 1979, Oregon cement production rose, but did not keep pace with demand. Shortages were reportedly slowing construction projects, especially in the Portland area. Clinker was imported from Japan and ground locally to supplement supplies. The State's only producer, Oregon Portland Cement Co., had its new cement plant onstream October 22, 1979. The company expects to have the 550,000-ton-per-year plant in full operation by early 1980. At a Department of Environmental Quality permit renewal hearing in September 1978, the firm's Lake Oswego plant in northern Clackamas County, near Portland, was the object of citizen complaints about noise and air pollution. A new operating permit was granted requiring the company to monitor and improve dust control.

Clays.—Clays were produced both years in six counties: Baker, Benton, Clackamas, Klamath, Malheur, and Multnomah. U were in cement, brick, tile, pottery, a animal-food supplements. In Clackam County, a carbonaceous material sold a used as a soil conditioner and food supple ment, was produced from a Bureau of La Management coal lease. The mine a plant are near Wilhoit Springs, 8 mile north of Molalla in the foothills of th Cascade Mountains. A request by Columbi Brick Works to issue $4.45 million in ta exempt industrial bonds for new plant co struction was approved by the Oregon De partment of Economic Development. Th firm supplies a significant portion of th bricks used in the Portland area. Gle Teague produced bentonite in Malhe County for use as a binder in sand casting pond sealing, and fire retardant. The pro uct was treated at a mill near Adrian.

Diatomite.—Diatomite resources are ex tensive in Christmas Valley, Lake County In 1979, Oil-Dri West acquired America

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Fossil Co., an important producer of cat litter. Oil-Dri secured a $1.5 million industrial bond from the State's Economic Development Council, and used the money to purchase and expand the operation. Expansion resulted in an employment increase to 25 people.

Fertilizer.—Reichold Chemicals, Inc., manufactured ammonia and urea fertilizer at St. Helens in Columbia County, utilizing natural gas supplied from Canada. Occidental Chemical Co. was seeking permits necessary to construct a $25 million fertilizer importing, mixing, and transhipment facility at St. Helens. A liquefied ammonia carrier, built from a former tanker, was launched at Swan Island Ship Repair Yard, Portland. The ship will bring ammonia from Alaska to the Rivergate area of Portland.

Pumice—At a number of sites, nine producers extracted volcanic cinders and pumice for use in concrete aggregate, landscaping, road construction, and roofing. The validity of block pumice claims at Rock Mesa, in the Three Sisters Wilderness area, was the subject of hearings before a U.S. Department of the Interior administrative law judge. Mining claims by U.S. Pumice Co. were originally staked in 1961, and the firm has attempted during recent years to obtain mining permits to develop and initiate production at the property. Litigation against U.S. Pumice by the U.S. Forest Service, through the Bureau of Land Management, was initiated because development threatened the wilderness values of the area. A brief was filed by the U.S. Forest Service, and an answering brief submitted by the company. The decision is pending.

Sand and Gravel.—Of the 36 Oregon counties, 31 produced sand and gravel, led by Multnomah, Clackamas, and Lane.

The State Supreme Court ruled in August 1978, on a long-standing dispute between the State Land Board and Corvallis Sand and Gravel Co. (now Wildish Sand and Gravel Co.). The ruling holds that the State may not claim ownership of privately owned property that was immersed through natural changes. This does not alter a previous ruling by which the State had established statutory rights to all navigable riverbeds within its boundaries. The case was returned to State courts after a 1977 decision by the U.S. Supreme Court on riverbed ownership stating that disputes should be decided by State laws except where interstate boundaries are concerned.

In December 1978, the State Supreme Court upheld a 1977 decision of the State Court of Appeals that private users of submersible and submerged lands on navigable waterways may be charged a rental fee by the State Land Board. Board rules allow leasing of such lands for permanent or long-term uses such as marine facilities and other commerical uses. It had been contended that the Federal Government through the U.S. Army Corps of Engineers had exclusive control over navigable waterways.

A study of aggregate demand and resources in the Portland area was published by the State Department of Geology and Mineral Industries.[4] A published study provided demand forecasts for sand and gravel and stone for the State and several sub-State divisions. Forecasting methods were also outlined.[5] Sand and gravel producers along the Willamette River have been subject to increasing demands by special interest groups. As an example, a corporation that operates a 520-acre gravel pit east of Corvallis had to apply to the Benton County Planning Commission for permission to expand its mine area an additional 150 acres. A reclamation plan, which would eventually convert the entire area to resort and recreational use, accompanied the request. A decision is pending.

Stone.—The U.S. Forest Service was the leading producer of crushed stone.

The State Land Board granted a request from Oregon Portland Cement Co. to expand the area covered by a sandstone quarry lease on State Forestry Department land near Gnat Creek, Clatsop County. The product was shipped to the firm's Lake Oswego plant near Portland. The Land Board increased the royalty rate from 10 to 20 cents per ton and set a precedent by adding a 3.4-cent-per-ton charge to compensate for reducing site soil productivity. The surcharge revenue is to be held in an improvement fund to provide fertilizers at the time of reclamation.

At Oregon State University, two studies were published describing supply and demand for aggregate rock in the coastal areas of Oregon.[6] [7] These studies were partly funded by a Federal grant. Coastal rock materials are generally in short supply; furthermore, their quality is unsatisfactory for construction purposes. Shortages were said to be especially severe in the coastal portions of Lane and Lincoln Counties; the shortage hampered logging-road construction in the Siuslaw National For-

Table 4.—Oregon: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	4,052	$9,112	$2.25	5,005	$12,465	$2.49	3,963	$11,527	$2.91
Plaster and gunite sands	NA	NA	NA	74	203	2.75	35	120	3.48
Concrete products	1,007	2,641	2.62	940	2,524	2.69	1,000	2,760	2.76
Asphaltic concrete	2,661	6,183	2.32	3,912	9,835	2,51	3,727	10,169	2.73
Roadbase and coverings	5,543	11,901	2.15	6,441	14,815	2.32	7,039	17,376	2.47
Fill	2,355	2,997	1.27	2,314	3,558	1.54	1,771	3,108	1.76
Snow and ice control	NA	NA	NA	25	72	2.89	W	W	W
Railroad ballast	18	32	1.84	186	522	2.81	--	--	--
Other uses	196	250	1.32	235	414	1.76	339	769	2.26
Total[1] or average	15,833	33,127	2.09	19,130	44,510	2.33	17,874	45,829	2.56

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."
[1] Data may not add to totals shown because of independent rounding.

Table 5.—Oregon: Construction sand and gravel sold or used by producers

	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	4,048	$8,454	$2.09	5,666	$12,921	$2.28	5,614	$14,127	$2.52
Gravel	11,785	24,673	2.09	13,467	31,589	2.35	12,260	31,702	2.59
Total[1] or average	15,833	33,127	2.09	19,133	44,510	2.33	17,874	45,829	2.56

[1] Data may not add to totals shown because of independent rounding.

Table 6.—Oregon: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate	[r]445	[r]1,060	465	1,165	1,850	4,618
Bituminous aggregate	949	2,795	1,105	2,844	1,036	2,967
Macadam aggregate	640	1,830	273	639	775	2,221
Dense-graded roadbase stone	3,343	6,993	8,629	18,889	10,573	25,908
Surface treatment aggregate	1,868	3,689	1,037	2,481	1,686	4,790
Other construction aggregate and roadstone	8,863	19,345	4,794	9,916	8,004	19,307
Riprap and jetty stone	491	904	439	878	720	1,586
Railroad ballast	473	1,024	462	1,254	429	1,130
Filter stone	13	35	21	61	26	80
Manufactured fine aggregate (stone sand)	15	48	17	61	25	77
Ferrosilicon	19	297	--	--	25	W
Terrazzo and exposed aggregate	--	--	1	1	W	W
Drain fields	--	--	W	W	5	13
Fill	38	113	W	W	W	W
Other uses[2]	444	1,266	442	1,319	583	2,378
Total[3]	17,600	39,400	17,685	39,509	25,738	65,074

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."
[1] Includes limestone, granite, sandstone, traprock, and other stone.
[2] Includes stone used for agricultural limestone, poultry grit and mineral food, cement manufacture, glass manufacture (1977), sugar refining, other miscellaneous uses, and uses indicated by symbol W.
[3] Data may not add to totals shown because of independent rounding.

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est. New construction techniques and better utilization of available rock were also subjects of the studies.

Talc.—The production and use of soapstone in southwest Oregon were the subjects of a State report.[8] The area described is along Elliott Creek Ridge and Squaw Creek in the upper Applegate River drainage, southern Jackson County. Alaska and Canada were cited as good markets for soapstone carving blocks.

Zeolite.—In recent years, claims have been staked on zeolite deposits in the Rome area of Malheur County. Companies believe natural zeolite materials, occurring in vitric tuff beds once submerged in saline waters, have major economic value, although markets are yet to be fully developed.

Occidental Mineral Corp. was among claim holders in the area. The area is a scenic attraction near the Owyhee River, noted for boat trips and natural values for recreation purposes. Occidental requested a permit from the Federal government to mine its claims on Bureau of Land Management lands. As a result, a public hearing was called in August 1978, to consider issuance of a mining permit. Subsequently, part of the claims in the most scenic portion were relinquished, and an administrative law judge was expected to rule later on the permit.

METALS

Aluminum.—Martin Marietta Aluminum Inc., located at The Dalles, and Reynolds Metals Co., at Troutdale, operated at varying capacities, depending upon availability of electric power. In 1978, the companies restarted potlines that had been deactivated in 1977 because of regional electric power shortages. In 1979, the companies, operated under interruptible electric supply contracts, curtailing production as conditions warranted. Martin Marietta significantly reduced electrical consumption by improving the design of its potlines. Changes and additions were made to pollution control equipment to reduce quantities of several waste products. Forecasts of energy requirements were prepared by the State Department of Energy indicating that, despite expected higher electrical costs, operations can remain profitable if improvement continues in the efficient use of energy.[9]

Alumax Pacific Corp. closed a small office at Hermiston, near Umatilla (Umatilla County), where the firm had planned a major aluminum smelter. A court-ordered requirement that the Bonneville Power Administration prepare an environmental statement before providing electricity caused the company delay. Alumax reportedly spent more than $14 million in engineering, soil borings, land purchases, and other siting costs. These expenditures were in two geographic areas, at Warrenton (Clatsop County), and Umatilla (Umatilla County).

Alcoa Recyling Co. opened a recycling center in North Portland in late 1978. Monthly collections were expected to total 200,000 pounds of aluminum, mainly in scrap cans. Baled scrap was shipped to Alcoa's plant in Warrick County, Ind.

Copper, Gold, and Silver.—Companies exploring deposits in Oregon included Canadian Superior Exploration, Ltd., Johns-Manville Corp., Amoco Minerals Co., Noranda Exploration, Inc., Cominco American, Inc., Newmont Exploration, Ltd., Texasgulf, Inc., American Selco, Inc., Ibex Minerals, Inc., Homestake Mining Co., Exxon Minerals Co., W. A. Bowes & Associates, Chevron Resources, Inc., Gulf Minerals Corp., and Preussag, Ltd. Copper exploration was planned in the Camp Creek area, south of Unity, in Baker and Malheur Counties. In Marion County, on the Little North Fork of the Santiam River, core drilling continued at depth on a breccia dike containing values in copper. Geochemical studies were made of nearby mineralized areas. Drilling for copper was planned on a geochemical anomaly north of Medford, near Roundtop Mountain. Mines with past production were explored in southern Douglas County, Jackson County, and northern Josephine County.

Silver King Mines entered an agreement with Birch Creek Resources Co., a subsidiary of Texasgulf, Inc., to explore and develop the Iron Dyke gold-copper property near Homestead (Baker County). This action was taken after drilling revealed a large ore body beyond previous workings. Ore was to be mined at a rate of about 300 tons per day and trucked to the Silver King Mill located near Cuprum, Idaho. Ibex Minerals, Inc., signed an agreement with Centennial Exploration Co. to explore and develop the Bayhorse Silver Mine, located along the Snake River near Huntingdon (Baker County). Plans were considered by new owners of the Oregon King silver-gold mine near Ashwood (Jefferson County) to pump out and rehabilitate the workings.

At the Cougar and New York Mines near

Granite (Grant County), test work continued on a gold heap-leaching process; a small amount of gold was produced. The Dixie Meadows gold mine, north of Prairie City (Grant County), where heap leaching was also being tested, was sold in late 1978 to Canadian Natural Resources, Ltd. Small placer mining ventures operated intermittently in various locations in northeastern and southwestern Oregon, but production data were unavailable. A small amount of gold was produced as a byproduct of aggregate processing at the site of the Applegate Dam, under construction by the U.S. Army Corps of Engineers in Jackson County. Recovery was continuing in 1979.

Lead.—Bergsoe Metal Corp., a Danish company, announced in 1979 that it had optioned property in St. Helens, on the Columbia River, and planned to build a $14 million scrap lead recovery plant. A unique, nonpolluting process would be utilized in handling recycled lead-acid batteries; the plant would employ about 100 workers. A 2-year construction schedule was anticipated, including 6 months for obtaining necessary permits.

Nickel.—Despite a 6-week shutdown in 1978 of its nickel smelter at Riddle, the Hanna Mining Co. reported an increase in sales but with a decrease in value. Hanna's laterite mine and smelter complex is the only domestic source of primary nickel. Annual production is in the range of 13,000 to 15,000 tons of contained nickel in ferronickel. A 3-year union contract was negotiated at the end of July 1978. Research was conducted by Hanna on low-grade lateritic nickel ores from Oregon deposits.

The U.S. Bureau of Mines conducted nickel laterite exploration activities on Rough and Ready Ridge in Josephine County. At least five companies were active in consolidating claim holdings and staking additional claims on nickel-cobalt deposits in Josephine and Curry Counties. Additional research was conducted by the Bureau's Albany Research Center to perfect technology for recovering nickel and cobalt from Oregon and California laterites by a process of selective reduction, controlled oxidizing ammonia-ammonium sulfate leach, solvent extraction, and electrowinning. A contract was signed with UOP, Inc., for pilot-scale testing of the process to determine commercial parameters. Sampling was conducted in coordination with the Bureau's Western Field Operations Center, Spokane, Wash. The Oregon Department of Geology and Mineral Industries, with funding from the U.S. Bureau of Mines, completed and published a study of the State's nickel resources.[10] Assuming favorable economics, it was concluded that Nickel Mountain resources would probably last until the year 2000 at current rates of production. Two main areas of possible future production are the Illinois River Valley and Red Flat, in Josephine and Curry Counties, respectively.

Steel.—At a hearing in Portland on January 24, 1978, before the U.S. International Trade Commission (ITC), Gilmore Steel Corp., parent of Oregon Steel, provided testimony to demonstrate the serious economic impacts of price cutting by five Japanese steel producers. The investigation was ordered when the U.S. Treasury Department found that Japanese firms were selling carbon steel plate (Oregon Steel's primary product) below cost in the northwest. A company spokesman reported operating losses resulting from such pricing had amounted to several million dollars over a 3-year period, and that plant closure could result. In May 1978, ITC ruled that Oregon Steel had been injured by illegal "dumping" of Japanese carbon steel plate; receiving firms were ordered to pay tariffs of 5.4% to 18.5% on carbon steel imports since October 1977. Later in 1978, company officials renewed their complaints against overseas suppliers when tonnages of imported steel rose sharply.

The United Steelworkers strike at Oregon Steel, which began September 1, 1977, was settled February 19, 1978. Plans to build a new plant to heat-treat alloy plate were announced, with a target date for completion in late 1979.

Cascade Steel Rolling Mill, Inc., at McMinnville, utilized scrap and operated at near capacity. Under a $3.6 million Farmers Home Administration loan guarantee, the rolling mill was remodeled to improve efficiency on reinforcing bar and fence post products, and to allow expansion into a new line of merchant bar products.

Titanium.—Oregon Metallurgical Corp.'s (Ormet) titanium sponge plant suffered explosion damage late in 1977. Repairs were made and production resumed in the first half in 1978. Demand for the metal increased to an alltime high because of the commercial aircraft market. Shortages of titanium scrap, normally recycled from fabricator's plants, were reported in 1978-79. Ormet's titanium tetrachloride production facility was inactive because the compound,

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the base for sponge production, could be purchased more cheaply elsewhere. Ormet produced magnesium metal by electrolysis for its own titanium reduction; it is studying proposed plans for expansion of its titanium sponge plant.

Zirconium.—Because of a downturn in nuclear reactor orders, Teledyne Wah Chang Corp., the country's only zirconium producer, had less zirconium sponge output. More than half of the metal produced was destined for reloads in existing reactors. The plant was closed for 1 month during the past 2 years; owing to a slump in markets, the work force was reduced 17% by yearend. In August 1978, a public hearing was called by the Oregon Department of Environmental Quality on a Wah Chang permit request for a 20% increase in oxide production rates. Further hearings were held in October 1978 on compliance with existing permits; renewal was granted. No increase in pollution limits were allowed; subsequently, the company was fined for numerous violations. Wah Chang maintained that the limits were too low, and could not be met under existing technology. Radioactive wastes containing Radium-226 were discovered as an additional pollutant. An estimated 6,500 tons of this waste product was sent to Hanford, Wash., for disposal. Concern continued over remaining sludges because of solubility of this form of radium and the emanation of radon gases.

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[1] State mineral specialist, Bureau of Mines, Spokane, Wash.

[2] State Geologist, Oregon Department of Geology and Mineral Industries, Portland, Oreg.

[3] Economic geologist, Oregon Department of Geology and Mineral Industries, Portland, Oreg.

[4] Gray, J. J., G. R. Allen, and G. S. Mack. Rock Material Resources of Clackamas, Columbia, Multnomah, and Washington Counties, Oregon. Oreg. Dept. Geol. and Min. Ind., Spec. Paper 3, 1978, 54 pp.

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[7] Chintakovid, V. Evaluation of Aggregate Needs and Problems Along the Oregon Coast. Oreg. State Univ., Dept. Civil Eng.; project submitted to the Dept. Civil Eng. 1979, 107 pp.

[8] Peterson, N. V., and L. Ramp. Soapstone Industry in Southwest Oregon. Oreg. Dept. Geol. and Min. Ind., The Ore Bin, v. 40, No. 9, September 1978, pp. 148-157.

[9] Hassoun, H. Industrial Energy Consumption Studies Part I, The Aluminum Industry. Oreg. Dept. Energy, June 1978, 110 pp.

[10] Ramp, L. Investigation of Nickel in Oregon. Oreg. Dept. Geol. and Min. Ind., Paper 20, 1978, 68 pp.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum:			
Martin Marietta Aluminum, Inc	6801 Rock Ledge Dr. Bethesda, MD 20034	Smelter	Linn.
Reynolds Metals Co	Troutdale, OR 97060	Plant	Multnomah.
Cement:			
Oregon Portland Cement Co.[1]	111 SE. Madison St. Portland, OR 97214	Plants	Baker and Clackamas.
Diatomite:			
American Fossil, Inc.	Box 203 Christmas Valley, OR 97638	Mine and plant	Lake.
Ferroalloys:			
National Metallurgical Corp	Springfield, OR 97477	Plant	Lane.
Union Carbide Corp	Portland, OR 97200	do	Multnomah.
Lime:			
Amalgamated Sugar Co	Nyssa, OR 97913	do	Malheur.
Ash Grove Cement Co	101 West 11th St. Kansas City, MO 64105	do	Multnomah.
Nickel:			
Hanna Mining Co	Riddle, OR 97469	Mine and plant	Douglas.
Pumice:			
Central Oregon Pumice Co	5 Greenwood Ave. Bend, OR 97701	do	Deschutes.
Graystone Corp.	Box 1087 Bend, OR 97701	do	Do.
Sand and gravel:			
Cascade Aggregates Co	Box 583 Scappoose, OR 97056	do	Columbia.
Willamette Western Co	Foot of North Portsmouth Ave. Portland, OR 97203	Dredge and plant.	Multnomah.
Beaver State Sand and Gravel	Box 1427 Roseburg, OR 97070	Surface mine	Douglas.
Joe Bernert Towing Co	Box 37 Wilsonville, OR 97070	do	Clackamas.

See footnotes at end of table.

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Table 7.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel —Continued			
Copeland Sand and Gravel Co	695 SE. J Grants Pass, OR 97526	do	Josephine.
Portland Road & Driveway Co	7295 SE. King Rd. Portland, OR 97222	do	Clackamas.
Ross Island Sand & Gravel Co	4129 SE. McLoughlin Portland, OR 97202	do	Multnomah.
Scappoose Sand & Gravel Co	Route 2, Box 1 Scappoose, OR 97056	do	Columbia.
Wildish Sand & Gravel Co	Box 1106 Eugene, OR 97401	do	Lane.
Delta Sand & Gravel Co	999 Division Ave. Eugene, OR 97301	do	Do.
Cascade Aggregates, Inc	Box 1225 Scappoose, OR 97056	do	Columbia.
Gresham Sand & Gravel Co	2039 SE. 195th Ave. Gresham, OR 97030	do	Multnomah.
Lininger & Sons, Inc	Box 1145 Medford, OR 97501	do	Jackson.
Steel:			
Cascade Steel Rolling Mills, Inc	McMinnville, OR 97128	Plant	Yamhill.
Oregon Steel Mills	Portland, OR 97200	do	Multnomah.
Stone:			
U.S. Forest Service	319 SW. Pine St. Portland, OR 97208	Quarries	Various.
L. H. Cobb	21305 SW. Koehler Rd. Beaverton, OR 97005	Quarry and plant.	Washington.
Progress Quarry, Inc	14515 Scholls Ferry Rd. Beaverton, OR 97005	do	Do.
Rogers Construction Co	Box 16537 Portland, OR 97216	Quarries	Do.
L. V. Anderson Construction Co	Box 757 Oakridge, OR 97463	do	Various.
Baker Rock Crushing Co	2030 East Main St. Hillsboro, OR 97123	do	Washington.
R C. Gilbert, Inc	2000 Armory Dr. Medford, OR 97501	do	Jackson.
C C. Meisel Co	Box 206 McMinnville, OR 97128	do	Yamhill.
Roseburg Sand & Gravel Co	Box 1207 Roseberg, OR 97470	do	Douglas.
Springfield Quarry Rock Products Co.	702 South 28th Springfield, OR 97477	do	Lane.
Talc and soapstone:			
John H. Pugh	2891 Elk Lane Grants Pass, OR 97526	Mine	Josephine.
Titanium:			
Oregon Metallurgical Corp	Box 580 Albany, OR 97321	Plant	Linn.
Vermiculite (exfoliated):			
Supreme Perlite Co	4600 North Suttle Rd. Portland, OR 97217	do	Multnomah.
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	do	Do.
Zirconium:			
Teledyne Wah Chang Albany Corp	Box 460 Albany, OR 97321	do	Linn.

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[1] Also stone and clays.

The Mineral Industry of Pennsylvania

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Pennsylvania Bureau of Topographic and Geologic Survey, Department of Environmental Resources, to collect information covering all nonfuel mineral production from mines and quarries.

By William Kebblish[1]

The value of Pennsylvania's mineral production, excluding fuels, was $629.5 million in 1978 and $722.6 million in 1979. Production value increased for masonry and portland cement, clays, lime, peat, and crushed stone, compared with production values for 1977; but, value declined in 1978 for dimension stone and zinc, rebounding to higher levels in 1979.

Nationally, Pennsylvania ranked high in mineral production and led in the production of masonry cement and cadmium. The State was second in the production of lime, pig iron, finished iron oxide pigments and other iron oxide materials (both natural and synthetic), slag, and stone; third in portland cement output; fifth in dimension stone output; and seventh in the production of zinc, crude mica, and clay and shale. Leading producing counties were York (cement and stone), Butler (lime, cement, and stone), Huntingdon (stone), and Armstrong (sand and gravel, clays, and stone).

Trends and Developments.—At the end of 1978, the Environmental Protection Agency (EPA) drafted air regulations requiring dry emission-control systems for certain mineral-processing plants. The proposed rules would apply to new, modified, or rebuilt plants that process nonmetals, with only a minimal impact on existing plants. The dry emission-control systems, better known as baghouses, would be used primarily in the stone, sand and gravel, and cement industries, all of which are important industries in Pennsylvania.

The environmental effects of dredging for sand and gravel in the Allegheny River became an issue in 1978 and 1979 and resulted in hearings held by the U.S. Army Corps of Engineers. As a result, the Corps of Engineers requested EPA to prepare an environmental impact statement on dredging of the Allegheny. The Corps also withheld action on new dredging permits, but existing permits remained valid.

United States Steel Corp. announced plans to construct a new steel mill on Lake Erie at the Pennsylvania-Ohio border. It was expected that the $3 to $4 billion plant would be completed in 8 years, providing over 8,000 jobs. Steel production was projected at over 6 million short tons annually, or about 17% of the firm's existing capacity. Pennsylvania authorities had no objections to the proposed plant, and the application for construction awaited approval from the Corps of Engineers and EPA.

Planned improvements by steel companies in the Pittsburgh area included four electric furnaces, two by Jones & Laughlin Steel Corp. and two by Crucible Alloys. Wheeling-Pittsburgh Steel Corp. planned to construct a rail mill, and Monongahela Steel Corp. planned to build a reinforcing bar and rod mill. In the Johnstown area, Bethlehem Steel Corp. planned to install a new electric melt shop, and Abex Corp. planned to produce railroad wheels.

Legislation and Government Programs.—The Pennsylvania General Assembly passed five bills pertaining to the min-

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Table 1.—Nonfuel mineral production in Pennsylvania[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:						
Masonry ---- thousand short tons--	411	$19,927	445	$22,803	415	$24,177
Portland ---------- do----	6,162	196,443	6,750	228,568	6,508	259,756
Clays[2] ---------- do----	2,304	13,075	2,571	18,175	2,468	20,099
Gem stones ----------	NA	10	--	--	--	--
Lime ---- thousand short tons--	2,007	72,591	2,126	83,869	2,153	96,569
Mica (scrap) ---------- do----	1	W	2	W	4	W
Peat ---------- do----	16	353	23	435	24	531
Sand and gravel ---------- do----	18,846	52,578	[3]19,135	[3]51,243	20,150	71,740
Stone:						
Crushed ---------- do----	63,522	163,652	69,041	194,518	71,730	224,908
Dimension ---------- do----	66	5,362	70	5,215	77	5,961
Zinc (recoverable content of ores, etc.) metric tons--	20,706	15,703	19,099	13,053	21,447	17,636
Combined value of clays (kaolin), copper (1977), iron ore (1977), sand and gravel (industrial, 1978), tripoli, and values indicated by symbol W ----------	XX	20,002	XX	11,637	XX	1,237
Total ----------	XX	559,696	XX	629,516	XX	722,614

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes kaolin; value included in "Combined value" figure.

[3] Excludes industrial sand; value included in "Combined value" figure.

ing industry that were signed into law during 1978 and 1979. Act 1978-5 specified duties of a blaster; Act 1978-314 regulated construction and storage in manmade caverns; Act 1978-98 provided additional land near the Cornwall Furnace to the Pennsylvania Historical and Museum Commission; and Act 1978-333 designated the Schuylkill River as a scenic river, thereby precluding mineral extraction along the river corridor.

Mineral extraction was also banned northeast of Stroudsburg along a section of the upper Delaware River, which forms the boundary between Pennsylvania and New Jersey. This region was declared a wild and scenic river through Federal legislation. Previously, the Corps of Engineers had planned to construct the Tocks Island Dam in this region, but these plans were abandoned in 1978. Federal legislation transferred land acquired for the dam to the National Park Service for use as a recreational area.

Under the Coastal Zone Management Act of 1972, Pennsylvania qualified as a coastal State, owing to its 63-mile shoreline on Lake Erie and the 55-mile segment of the tidal Delaware River that is within the State in the Philadelphia area. A technical plan drafted by the State in 1978 not only provided for the protection and development of coastal resources, but also established guidelines for the mineral-extraction industries. The State Coastal Program must be approved by the Governor and the U.S. Department of Commerce before the State can receive Federal funds for administration of the program.

Legislation establishing the Coal and Clay Mine Subsidence Insurance Fund passed in 1971 and was amended in 1979 for clarity with respect to insurance policies. New policies sold in 1978 and 1979 totaled slightly over 3,000, bringing the total number of policies sold to 11,606. Claims paid to 85 policyholders in 1978 and 1979 amounted to $570,000.

The State's Department of Environmental Resources implemented performance standards as required by the Federal Surface Mining Control Act of 1977, reviewed current reclamation laws, and developed a State surface mining control program that was expected to lead to primacy under the Federal Act. The Pennsylvania program was expected to be submitted to the U.S. Office of Surface Mining for approval in 1980.

Employment.—In 1978, approximately 10,000 people were employed in Pennsylvania's metal and nonmetal mining industry. The stone industry employed slightly more than 79% of the total. The sand and gravel industry was the next largest of the mining industry's employers, with approximately 10% of the total; and 8% of the mineworkers were employed in other nonmetal industries, such as clay shale, magnesite, and peat operations. The metal industry employed the remaining 3% of the State's mining work force, mostly in the eastern part of the State.

Table 2.—Value of nonfuel mineral production in Pennsylvania, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Adams	W	W	Stone, lime, clays, mica.
Allegheny	$25,455	W	Cement, clays, sand and gravel, stone.
Armstrong	9,667	$10,941	Sand and gravel, clays, stone.
Beaver	W	7,777	Sand and gravel, clays.
Bedford	2,334	2,438	Stone, sand and gravel.
Berks	47,702	W	Cement, stone, clays, sand and gravel.
Blair	W	W	Stone, sand and gravel.
Bradford	W	W	Sand and gravel, stone.
Bucks	W	W	Stone, sand and gravel, clays.
Butler	26,089	32,651	Lime, cement, stone, sand and gravel, clays.
Cambria	W	W	Stone.
Cameron	W	W	Sand and gravel.
Carbon	W	W	Sand and gravel, stone.
Centre	W	W	Lime, stone, clays.
Chester	W	W	Stone, lime, clays.
Clarion	W	W	Stone.
Clearfield	W	W	Clays, stone, sand and gravel.
Clinton	W	W	Stone, clays.
Columbia	W	W	Sand and gravel, stone.
Crawford	1,549	1,210	Sand and gravel.
Cumberland	4,544	W	Stone, sand and gravel, clays.
Dauphin	W	W	Stone, sand and gravel.
Delaware	W	W	Stone.
Elk	W	W	Do.
Erie	4,591	4,616	Sand and gravel, peat.
Fayette	W	5,545	Stone, clays.
Forest	W	W	Sand and gravel, stone.
Franklin	W	W	Stone, sand and gravel.
Fulton	W	W	Do.
Huntingdon	W	W	Stone.
Indiana	W	--	
Jefferson	W	W	Clays, stone.
Juanita	--	W	Stone.
Lackawanna	W	905	Stone, sand and gravel, peat.
Lancaster	W	W	Stone, clays, sand and gravel.
Lawrence	W	W	Cement, stone, sand and gravel, clays, peat.
Lebanon	W	W	Lime, stone.
Lehigh	W	W	Cement, zinc, stone.
Luzerne	5,041	W	Stone, sand and gravel, peat.
Lycoming	W	W	Stone, sand and gravel.
McKean	W	W	Clays, stone.
Mercer	W	W	Sand and gravel, stone.
Mifflin	W	W	Stone, sand and gravel, lime.
Monroe	W	W	Stone, sand and gravel, clays, peat.
Montgomery	W	W	Stone, lime, cement, clays.
Montour	W	W	Stone.
Northampton	W	W	Cement, stone, sand and gravel.
Northumberland	W	W	Stone, sand and gravel, clays, tripoli.
Perry	W	W	Stone.
Pike	W	W	Stone, sand and gravel, peat.
Potter	36	W	Stone.
Schuylkill	1,192	1,431	Stone, sand and gravel.
Snyder	W	W	Stone.
Somerset	W	3,684	Stone, clays, sand and gravel.
Susquehanna	1,122	W	Stone.
Tioga	1,468	1,106	Stone, sand and gravel.
Union	W	W	Stone, clays.
Venango	1,137	1,120	Sand and gravel.
Warren	1,365	1,687	Do.
Wayne	2,010	W	Stone, sand and gravel.
Westmoreland	W	W	Do.
Wyoming	W	W	Sand and gravel.
York	47,632	52,480	Cement, stone, lime, sand and gravel, clays.
Undistributed[2]	376,763	501,921	
Total[3]	559,696	629,516	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Greene, Philadelphia, Sullivan, and Washington Counties are not listed because no nonfuel mineral production was reported.

[2] Includes gem stones and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

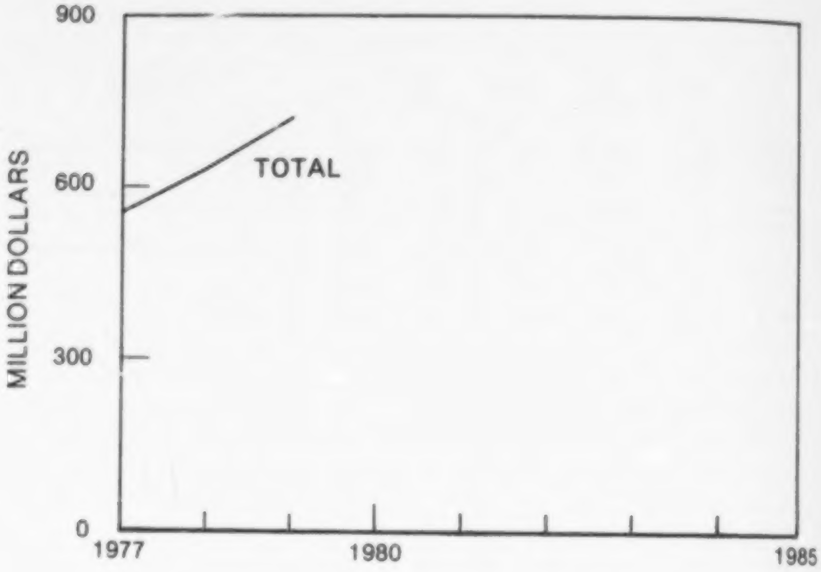

Figure 1.—Total value of nonfuel mineral production in Pennsylvania.

Table 3.—Indicators of Pennsylvania business activity

	1977	1978	1979^p	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	5,168.0	5,255.0	5,296.0	+0.8
Unemployment do	398.0	364.0	366.0	+10.5
Employment (nonagricultural):				
Mining[1] do	48.0	46.8	52.0	+11.1
Manufacturing do	1,341.9	1,369.2	1,389.8	+1.5
Contract construction do	183.9	199.0	205.8	+3.4
Transportation and public utilities do	261.6	267.2	273.1	+2.2
Wholesale and retail trade do	938.9	983.7	990.0	+.6
Finance, insurance, real estate do	217.5	226.6	235.4	+3.9
Services do	862.5	907.2	961.8	+6.0
Government do	710.9	724.9	722.7	-.3
Total nonagricultural employment[1] do	4,565.2	4,724.6	4,830.6	+2.2
Personal income:				
Total millions	$82,579.0	$90,991.0	$100,400.0	+10.3
Per capita	$7,000.0	$7,744.0	$8,559.0	+10.5
Construction activity:				
Number of private and public residential units authorized	50,298.0	[2]53,985.0	43,795.0	-18.9
Value of nonresidential construction millions	$464.4	$570.2	$686.4	+20.4
Value of State road contract awards do	$150.0	$60.0	$105.5	+75.8
Shipments of portland and masonry cement to and within the State thousand short tons	3,126.0	3,227.0	3,067.0	-5.0
Nonfuel mineral production value:				
Total crude mineral value millions	$559.7	$629.5	$722.6	+14.8
Value per capita, resident population	$47.0	$54.0	$62.0	+14.8
Value per square mile	$12,346.0	$13,886.0	$15,940.0	+14.8

^{p}Preliminary.

[1] Includes coal (anthracite and bituminous), gas, and oil extraction.

[2] Series revised in 1978, data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Nationally, Pennsylvania ranked first in 1979 in the production of masonry cement and third, behind California and Texas, in the production and production value of portland cement. Masonry cement was produced at 17 plants in 8 counties. Compared with the data for 1978, shipments in 1979 decreased, but value increased.

Portland cement was produced at 17 plants in 7 counties. Shipments and production value decreased in 1979, compared with the data for 1978, owing to a decline in the housing and construction industries. The leading producing counties were Northampton and Lawrence. Other producing counties included Allegheny, Berks, Butler, Lehigh, Montgomery, and York.

Major producers of portland and masonry cement included Amcord, Inc., Coplay Cement Manufacturing Co., Medusa Corp., National Gypsum Co., and U.S. Steel Corp. There has been little change in use patterns during recent years. Of the 6.5 million short tons of cement sold in 1979, approximately 54% was used by ready-mix companies, 28% was used in concrete products, 12% was used by building supply dealers, and the remaining 6% was used for other purposes.

Clays.—During 1978, 36 companies operated 85 clay and shale mines in 23 of Pennsylvania's 67 counties. The industry's structure was similar in 1979, but the production of clay and shale decreased in comparison with that of 1978. Clearfield County, with 12 operations, was the leading producing county. Other major counties, in descending order of production, were Lawrence, Berks, Beaver, York, and Armstrong.

The average unit value of clay and shale increased to $7.42 per short ton in 1978, and unit values continued to increase in 1979. Clay and shale were used mainly in the manufacture of face brick, firebrick, cements, flue linings, refractory products, and sewer pipe. Leading producers were Glen-Gery Corp., Medusa Corp., Hanley Co., and Resco Products, Inc.

Table 4.—Pennsylvania: Clays sold or used by producers, by use[1]

(Short tons)

Use	1977	1978	1979
Common brick	249,749	345,600	335,527
Face brick	957,680	1,135,311	1,091,641
Firebrick, block and shapes	473,438	502,652	581,107
Flue linings	162,993	136,077	70,673
Lightweight aggregates	10,700	W	W
Mortar and cement, refractory	62,525	65,754	81,012
Portland and other cements	162,256	184,168	159,604
Tile: Drain, quarry, and structural	58,149	53,100	51,557
Other uses[2]	82,720	59,450	45,897
Exports: Mortar, cement, other refractories	84,180	88,916	50,860
Total	2,304,390	2,571,028	2,467,878

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Excludes kaolin.

[2] Includes fertilizers, pottery, roofing granules, sewer pipe, terra cotta, and data indicated by symbol W.

Graphite.—Airco Speer Carbon Co. and Stackpole Carbon Co. (both in Elk County), and Charles Pfizer & Co., Inc. (in Northampton County), produced synthetic graphite for use in the manufacture of anodes, graphite shapes, crucibles and vessels, and electric-motor brushes.

Gypsum.—Imported gypsum was calcined by United States Gypsum Co. in Philadelphia County. Calcined gypsum was used mainly in the manufacture of prefabricated products, such as regular wallboard, type-X wallboard, and lath. These products were used extensively in home and commercial construction.

Iodine.—Whitmoyer Laboratories, Inc., in Lebanon County, and West-Agro Chemical, Inc., in Washington County, imported crude iodine from other States, which was used in the manufacture of pharmaceuticals, catalysts, and sanitation products.

Table 5.—Pennsylvania: Lime sold or used by producers, by use

Use	1977		1978		1979	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Steel, BOF	979,800	$34,971	1,041,750	$39,150	900,987	$40,411
Steel, electric	163,800	5,845	157,694	5,928	285,871	12,822
Sewage treatment	120,500	4,300	144,598	5,435	193,587	8,683
Water purification	255,100	9,106	245,714	9,236	185,710	8,329
Mason's lime	75,250	2,627	81,739	3,636	83,306	3,736
Steel, open-hearth	W	W	59,656	2,242	80,976	3,632
Acid mine water	W	W	W	W	69,606	3,122
Agriculture	23,710	930	23,869	1,052	23,154	1,038
Paper and pulp	38,900	1,389	21,609	812	20,504	920
Tanning	6,968	249	9,423	354	10,169	456
Petroleum refining	4,338	155	W	W	W	W
Soil stabilization	1,564	55	W	W	W	W
Other uses[1]	336,900	12,963	340,181	16,015	299,191	13,420
Total[2]	2,007,000	72,591	2,126,200	83,869	2,153,061	96,569

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes alkalies, construction lime (1979), explosives (1977-78), finishing lime (1977-78), glass, oil well drilling (1979), ore concentration, other chemical and industrial uses, other metallurgical uses (1978-79), paint, petrochemicals, refractory dolomite (1977-78), refractory lime (1979), rubber (1979), sand-lime brick, silica brick (1978-79), sugar refining (1977-78), sulfur removal (1979), wire drawing, and uses indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Lime.—Pennsylvania ranked second nationally, behind Ohio, in the production and production value of lime. Within the State, 10 plants were operated by 8 companies in 8 counties. Centre was the leading lime-producing county in the State, with three plants and 30% of the total production and production value. The other seven producing counties were, in alphabetical order, Adams, Butler, Chester, Lebanon, Mifflin, Montgomery, and York.

Domtar, Inc., in Bellefonte, Centre County, announced plans to spend $3.5 million to expand the capacity of its limestone plant near Bellefonte. The project plans included equipment modernization and the installation of pollution-control devices. The plant's production of quicklime was expected to increase by 120,000 short tons annually.

In 1978 and 1979, quicklime accounted for over 80% of the total lime produced in the State, and hydrated lime accounted for the remainder. The steel industry was the largest consumer of lime, and lesser amounts were used for water purification, sewage treatment, and agricultural purposes.

Mica.—Gross Minerals Corp., located in Adams County, produced scrap and flake mica by beneficiating schists and pegmatites. The product was used in mica paper and other electrical insulating materials.

Mullite.—A. P. Green Refractories, Philadelphia County, produced synthetic mullite by heating aluminum silicates to high temperatures. Mullite is a heat-resistant material used in furnace linings, refractories, and glass products. The production and production value of synthetic mullite in 1979 increased slightly, compared with those of 1978.

Peat.—Peat production in 1979 increased slightly, compared with those of 1978, with all production coming from the northeast and northwest part of the State. Six operations were located in Luzerne County, three were in Lackawanna County, and one each was located in Erie, Lawrence, and Pike Counties. Major producers were Corry Peat Products, Gouldsboro-Wayne Peat Co. Lake Benton Peat Moss, and Valliant Enterprises. Virtually all peat was used for agricultural and horticultural purposes. Moss peat comprised 7% of Pennsylvania's total peat production, reed-sedge comprised 57%, and humus accounted for the remaining 36%.

Perlite.—Crude perlite was shipped into six counties in the State and expanded at six plants by five companies. The total amount of expanded perlite sold or used in 1979 was 34,300 short tons valued at $3.9 million, reflecting a slight decrease in both production and production value, compared with those of 1978. Plants in western Pennsylvania were the Therm-O-Rock Div. of Allied Block Chemicals Co., located at New Eagle, Washington County, which began operating in 1978; and Perlite Manufacturing Co., located at Carnegie, Allegheny County. Producers in eastern Pennsylvania included Armstrong Cork Co., United States Gypsum Co., and Pennsylvania Perlite Corp. Perlite was used in plaster, cement aggregates, and for horticultural purposes. Minor uses included low-temperature insulation, fillers, foundry applications, insulating board, and bonding mortars.

Pyrophyllite.—Pyrophyllite was imported into the State and processed by American Olean Tile Co., Berks County. Pyrophyllite, a natural hydrous aluminum silicate found in metamorphic rocks, was used in ceramics and slate pencils. It is also a substitute for talc and is commonly termed "pencil stone." Other uses included cosmetics, insecticides, paint, and paper and rubber products.

Sand and Gravel.—Construction sand and gravel was produced by 128 companies in 39 of the State's 67 counties. Although production was approximately the same in 1978 and 1979, the value of production for 1979 increased more than 17% because of inflationary pressures. Beaver was the leading producing county, with 12% of the State's sand and gravel production, and was followed by Bucks, Armstrong, and Erie Counties. Construction sand and gravel was used primarily for concrete and asphalt aggregate, road base, and fill. Other uses were in concrete products, plaster, gunite, and for snow and ice control and railroad ballast. The 1979 unit value per short ton averaged $3.16, compared with $2.68 in 1978.

Nearly 82% of the State's construction sand and gravel was shipped to market by truck, 11% was shipped by water, and 1% was shipped by other means; the remainder was used at the originating plant sites. Leading producers were Davison Sand & Gravel Co., Dravo Corp., Erie Sand Steamship Co., and Warner Co.

Industrial sand was produced by McCrady Inc., Allegheny County, and Penn Glass Sand, Venango County. General uses were in glass manufacture, ferrous foundry operations, nonferrous operations, some chemical and metallurgical processes, and as fillers in manufactured products. Industrial sand data were withheld to avoid disclosing individual company proprietary data.

Table 6.—Pennsylvania: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	6,290	$16,242	$2.58	7,803	$21,601	$2.77	7,718	$26,405	$3.44
Plaster and gunite sands	NA	NA	NA	W	W	3.74	552	1,851	3.35
Concrete products	1,500	5,052	3.38	1,259	4,303	3.42	1,317	5,174	3.93
Asphaltic concrete	3,446	8,788	2.55	2,989	7,882	2.64	2,336	7,047	3.02
Roadbase and coverings	4,258	10,878	2.55	4,475	12,472	2.79	4,728	14,233	3.01
Fill	1,782	2,252	1.26	1,926	2,778	1.44	1,483	2,529	1.71
Snow and ice control	NA	NA	NA	197	598	3.04	245	802	3.27
Railroad ballast	45	126	2.76	47	129	2.71	45	126	2.76
Other uses	405	1,135	2.80	438	1,480	3.38	622	1,864	3.00
Total[1] or average	17,727	44,482	2.51	19,135	51,243	2.68	19,047	60,031	3.15

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."
[1] Data may not add to totals shown because of independent rounding.

Table 7.—Pennsylvania: Sand and gravel sold or used by producers, by use

	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	8,899	$22,808	$2.56	9,622	$25,721	$2.67	9,787	$30,312	$3.10
Gravel	8,828	21,674	2.46	9,513	25,522	2.68	9,261	29,718	3.21
Total[1] or average	17,727	44,482	2.51	19,135	51,243	2.68	19,047	60,031	3.15
Industrial sand	1,120	8,095	7.23	W	W	W	1,102	11,709	10.62
Grand total[1] or average	18,846	52,578	2.79	W	W	W	20,150	71,740	3.57

W Withheld to avoid disclosing company proprietary data.
[1] Data may not add to totals shown because of independent rounding.

Table 8.—Pennsylvania: Construction sand and gravel sold or used, by county

(Thousand short tons and thousand dollars)

County	1977			1978			1979		
	Quantity	Value	Number of companies	Quantity	Value	Number of companies	Quantity	Value	Number of companies
Allegheny	W	W	1	W	W	1	W	W	1
Armstrong	1,945	6,891	4	2,161	7,454	3	2,308	8,820	3
Beaver	2,144	5,028	4	2,577	6,593	4	2,435	11,097	4
Bedford	3	7	1	3	7	1	3	7	1
Berks	W	405	2	W	W	2	53	79	1
Blair	W	W	1	11	W	1	W	W	1
Bradford	W	W	2	306	850	4	373	1,017	6
Bucks	1,519	2,760	4	2,511	4,772	3	2,955	7,443	3
Butler	1	W	2	293	W	2	293	W	2
Cameron	W	W	1	W	W	1	W	W	1
Carbon	W	W	2	460	1,391	3	408	1,374	3
Clarion	--	--	--	--	--	--	W	W	1
Clearfield	W	W	--	W	W	1	W	W	1
Clinton	W	W	1	--	--	--	--	--	--
Columbia	300	525	1	W	W	2	W	W	2
Crawford	763	1,549	7	560	1,210	7	335	917	8
Cumberland	262	753	3	223	801	3	W	470	2
Dauphin	W	W	1	W	W	1	W	W	1
Erie	2,077	4,528	15	2,083	4,566	16	1,907	4,584	15
Forest	W	W	2	W	W	2	W	W	2
Franklin	W	W	1	W	W	1	W	W	1
Fulton	W	W	1	W	W	1	W	W	1
Huntingdon	W	W	1	--	--	--	W	W	1
Lackawanna	100	175	1	W	W	2	W	W	2
Lancaster	W	W	2	98	371	1	98	371	1
Lawrence	727	1,934	9	649	1,982	9	622	2,118	9
Luzerne	900	2,238	5	898	2,684	6	949	2,578	8
Lycoming	W	W	1	W	W	1	W	W	1
Mercer	443	965	3	552	1,219	6	662	1,572	6
Mifflin	W	W	1	W	W	1	W	W	1
Monroe	440	860	5	319	540	4	223	509	4
Northampton	W	W	2	W	W	1	W	W	2
Northumberland	238	707	1	247	823	1	248	871	1
Philadelphia	--	--	--	--	--	--	W	W	1
Pike	W	W	2	149	441	3	248	639	4
Schuylkill	74	299	1	70	474	1	W	W	1
Somerset	W	W	1	W	59	1	12	41	1
Susquehanna	--	--	--	--	--	--	W	W	1
Tioga	410	577	5	332	461	4	182	199	3
Venango	509	1,137	7	501	1,120	6	436	889	5
Warren	608	1,365	13	644	1,687	9	481	1,359	10
Wayne	292	738	3	W	W	2	137	338	3
Westmoreland	W	W	1	W	W	1	W	W	1
Wyoming	W	W	2	W	W	2	W	W	2
York	W	W	2	W	W	2	W	W	2
Undistributed	3,971	11,041	--	3,488	11,738	--	3,679	12,739	--
Total	17,727	44,482	124	19,135	51,243	122	19,047	60,031	130

W Withheld to avoid disclosing company proprietary data, included in "Undistributed."

Slag.—Iron and Steel Nationally, Pennsylvania was second, behind Ohio, in slag production. Slag is a byproduct of the steelmaking process. Total slag produced in 1979 amounted to 7.3 million short tons valued at $27.5 million. Production increased nearly 6% in value over that of 1978, but decreased nearly 9% in quantity owing to a decrease in steel production. Approximately 83% of the total slag produced was blast furnace slag, and the remaining 17% was iron and steel slag.

Types of blast furnace slag that were produced included air-cooled, expanded, and granulated. Major uses of air-cooled slag were for asphalt and concrete aggregate and as a road base material. Expanded slag was used in concrete products, and granulated slag was used for road base material, fill, and cement manufacture. Steel slag was used mainly for road base material.

Leading sellers of slag were Duquesne Slag Products Co., Warner Co., Bethlehem Mines Corp., Standard Slag Co., and Dunbar Slag Co.

Stone.—Pennsylvania led the Nation in the value of total stone produced, but ranked second to Texas in quantity. The State's 254 operations, 227 of which produced crushed stone products, were located in 55 of the State's 67 counties. Northampton County led with 17 quarries, Bucks and Lancaster Counties each had 16 quarries, and Berks County had 15. The 12 largest quarries had a combined production of more than 26% of the State's total; the 57 smallest accounted for less than 0.5% of the total. The unit value for all categories of crushed stone in 1978 was $2.90 per short ton. The highest unit value was that of crushed granite, at $4.82 per short ton.

During 1978 and 1979, approximately 85% of the crushed stone was shipped to market by truck, 5% was shipped by rail, and 10% was shipped by water. Major crushed stone producers were Bethlehem Steel Corp., New Enterprise Stone & Lime Co., Inc., and Warner Co.

In 1978 and 1979, Pennsylvania ranked fifth nationally, behind Georgia, Indiana, Ohio, and Vermont, in dimension stone production, with nearly 75,000 short tons of output valued in excess of $5 million. Stone was quarried at 27 operations in 10 counties. The leading producing counties were Northampton, Chester, and Bucks. The unit value of dimension stone was nearly $75 in 1978. Uses were for home and commercial construction. Major producers were Delaware Quarries, A. Dalley & Sons, Inc., Clan Bldg. Corp., and Media Quarry Co.

Table 9.—Pennsylvania: Dimension stone[1] sold or used by producers, by use

Use	1977			1978			1979		
	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)
Rough stone:									
Rough blocks	--	--	--	269	3	$20	--	--	--
Irregular-shaped stone	18,790	241	$373	17,364	223	367	21,199	271	$535
Rubble	[r]1,749	22	19	6,038	77	127	1,831	23	23
Monumental	3,583	43	439	3,621	36	394	W	W	W
Flagging	1,494	19	48	2,799	36	98	1,785	23	66
Dressed stone:									
Cut	W	W	W	W	W	W	16,946	13	690
Flagging	10,704	124	569	9,126	104	471	9,098	104	553
Roofing slate (standard)	4,856	53	912	2,774	31	667	2,789	31	721
Structural and sanitary	4,520	50	1,633	4,113	45	1,645	4,653	51	2,053
Blackboards	134	1	107	215	2	51	146	2	58
Billiard table tops	[r]2,090	23	451	844	9	238	W	W	W
Flooring slate	[r]1,565	[r]17	[r]197	497	5	133	641	7	133
Other uses[2]	16,394	201	614	22,272	269	1,004	17,558	189	1,128
Total[3]	65,879	794	5,362	69,932	841	5,215	76,646	714	5,961

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes granite, sandstone, slate, and other stone.

[2] Includes stone used in dressed construction, electrical fixtures (1977-78), unspecified uses, and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 10.—Pennsylvania: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	1,550	7,541	1,497	8,282	1,728	10,028
Agricultural marl and other soil conditioners	--	--	--	--	110	763
Poultry grit and mineral food	58	W	W	W	W	W
Concrete aggregate	[r]5,499	13,765	5,258	14,442	5,409	17,232
Bituminous aggregate	6,462	17,296	6,543	19,117	6,057	19,520
Macadam aggregate	1,389	3,175	1,539	3,944	1,692	4,991
Dense-graded roadbase stone	14,704	35,849	15,077	39,545	13,737	40,445
Surface treatment aggregate	2,784	6,875	2,568	6,652	2,878	9,003
Other construction aggregate and roadstone	12,283	27,533	14,621	36,264	17,732	50,981
Riprap and jetty stone	984	2,460	922	2,522	922	3,005
Railroad ballast	1,630	4,646	1,473	4,111	1,589	5,097
Filter stone	372	1,119	477	1,604	545	2,065
Manufactured fine aggregate (stone sand)	859	2,835	1,310	4,339	1,561	5,752
Terrazzo and exposed aggregate	157	598	W	W	231	956
Cement manufacture	8,035	15,590	9,125	19,196	9,485	20,556
Lime manufacture	[r]2,975	[r]8,877	3,217	10,427	3,259	10,854
Dead-burned dolomite	W	W	W	W	438	1,972
Flux stone	2,306	8,026	2,767	11,075	2,955	12,199
Refractory stone	40	436	527	3,079	72	1,262
Abrasives	W	W	37	310	W	W
Mine dusting	127	1,233	126	1,296	131	1,683
Asphalt filler	117	777	68	454	108	636
Other fillers or extenders	102	1,463	202	2,342	147	2,073

See footnotes at end of table.

Table 10.—Pennsylvania: Crushed stone[1] sold or used by producers, by use —Continued

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Building products	30	W	133	315	124	334
Acid neutralization	9	W	---	---	---	---
Glass manufacture	W	W	101	843	W	W
Other uses[2]	[r]1,049	[r]3,557	1,453	4,358	819	3,503
Total[3]	63,522	163,652	69,041	194,518	71,730	224,908

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, sandstone, traprock, and other stone.

[2] Includes whiting or whiting substitute, (1977-78), roofing granules, (1978-79), fill, waste material (1977), chemical stone for alkali work (1979), unspecified uses, and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Sulfur.—Three petroleum refineries in Philadelphia and Delaware Counties and one steel company in Allegheny County produced elemental sulfur in 1978 and 1979. Production during the 2-year period totaled 144,519 long tons valued at more than of $6 million.

Elemental sulfur was produced in the desulfurization of refinery gases. A lesser amount was produced in the treatment of natural gas. Principal uses were in the manufacture of sulfuric acid for fertilizers, in the leaching of ores, and in chemicals, fibers, paints, and explosives.

Tripoli.—Keystone Filler & Manufacturing Co.'s Sheddy mine in Northumberland County produced tripoli, which was used as an abrasive and filler.

Vermiculite (Exfoliated).—Crude vermiculite shipped into the State was exfoliated by J. P. Austin, Inc., Hyzer & Lewellen, Inc., and W. R. Grace & Co., located in Allegheny, Bucks, and Lawrence Counties, respectively. Major uses were for lightweight concrete aggregate, loose-fill insulation, horticultural purposes, and soil conditioning.

METALS

Abrasives (Manufactured).—Manufactured abrasives, consisting of steel shot and grit, were produced by Durasteel Abrasive Co., in Westmoreland County; and Carborundum Co. and Ervin Industries, both in Butler County. Silicon carbide, another manufactured abrasive, was produced by Satellite Alloy Corp., Allegheny County. The finished products were used as abrasives and in refractories.

Cadmium.—In 1978, Pennsylvania ranked first nationally in the smelter production of cadmium. The primary producer of cadmium was New Jersey Zinc Co. in Lehigh County. Production averaged about 7 pounds per ton of slab zinc produced. Cadmium was used for electroplating, plastic stabilizers, and pigments.

Iron Ore.—Bethlehem Steel Corp.'s Grace mine, located near Morgantown in Berks County, remained closed in 1978 and 1979. The mine was closed in 1977, idling approximately 850 workers.

Iron Oxide Pigments.—Pfizer, Inc., and Reichard-Coulston, Inc., both in Northampton County, produced natural and synthetic oxides. Natural oxides were also produced by the Prince Manufacturing Co., Carbon County; Foote Mineral Co., Chester County; and Chemalloy Co., Inc., Montgomery County.

The production of natural and synthetic iron oxide pigments in 1979, excluding regenerator oxides, totaled 34,000 short tons valued at $24 million, reflecting a slight increase over those of 1978. Regenerator oxides were produced from steel plant dust.

Iron oxide pigments were used in paints, rubber products, plastics, concrete products, paper, magnetic ink, and fertilizers.

Iron and Steel.—In 1979, shipments of pig iron totaled slightly more than 19 million short tons valued at more than $3.6 billion, representing a slight increase over shipments in 1978. In December 1979, 28 blast furnaces were active and 16 were idle. In December 1975, there had been a total of 50 blast furnaces—25 operating and 25 idle.

Basic pig iron accounted for 86% of total blast furnace production in 1978 and 92% of the total in 1979. Types of pig iron produced were foundry, bessemer, malleable, and direct castings.

Zinc.—Pennsylvania ranked fifth nationally in zinc production in 1979, producing 21,447 metric tons valued at $17.6 million. These figures reflected an increase of 12% in quantity and 35% in value, over those of 1978. In 1979, the unit price of zinc was 37 cents per pound. Zinc was used mainly for galvanizing, brass and brass products, castings, paints, and chemical products. Lehigh

County, located in the eastern part of the State, was the only county in which zinc was produced. In western Pennsylvania, St. Joe Minerals Corp., located in Monaca, Beaver County, closed its zinc smelter in late 1979. The company had no plans for reopening the operation.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasives: Satellite Alloy Corp	Satellite Industrial Park Box 171 Springdale, PA 15144	Plant	Allegheny.
Cement:			
Amcord, Inc.[1]	610 Newport Center Dr. Newport Beach, CA 92660	do	Northampton.
Coplay Cement Manufacturing Co.[1]	Nazareth, PA 18064	do	Lehigh and Northampton.
Keystone Portland Cement Co.[1]	Box 1785 Allentown, PA 18105	do	Northampton.
Louisville Cement Co	501 South 2d St. Louisville, KY 40202	do	Lawrence.
Medusa Corp.[1,2]	Box 5668 Cleveland, OH 44101	do	Lawrence and York.
Penn-Dixie Industries, Inc.[1,2]	60 East 42d St. New York, NY 10017	do	Butler and Northampton.
United States Steel Corp.[1]	600 Grant St. Pittsburgh, PA 15230	do	Allegheny and Northampton.
Clays:			
Dresser Industries, Inc	Box 6504 Houston, TX 77005	Pit	Clearfield and Somerset.
Glen-Gery Corp	227 North 5th St. Reading, PA 19601	Pit	Adams, Berks, Northumberland, Union, York.
Hanley Co	28 Kennedy St. Bradford, PA 16701	Pit	Jefferson and McKean.
Resco Products	Box 108 Morristown, PA 19404	Pit	Clearfield and Huntingdon.
Graphite, synthetic:			
Airco Speer Carbon	800 Theresia St. St. Marys, PA 15857	Plant	Elk.
Charles Pfizer & Co., Inc	235 East 42d St. New York, NY 10017	do	Northampton.
Stackpole Carbon Co	St. Marys, PA 15857	do	Elk.
Gypsum, calcined: United States Gypsum Co.[3]	101 South Wacker Dr. Chicago, IL 60606	do	Philadelphia.
Iron oxide pigments:			
The Prince Manufacturing Co	Bowmanstown, PA 18030	do	Carbon.
Reichard-Coulston, Inc	15 East 26th St. New York, NY 10010	do	Northampton.
Lime:			
The J. E. Baker Co.[1]	Box 1189 York, PA 17405	do	York.
Mercer Lime & Stone Co	1640 Oliver Bldg. Pittsburgh, PA 15222	do	Butler.
Peat:			
Lake Benton Peat Moss	1418 North Main St. Scranton, PA 18508	Bog	Lackawanna.
Perlite, expanded:			
Armstrong Cork Co	Lancaster, PA 17603	Plant	Lancaster.
Pennsylvania Perlite Corp	Box 2002 Lehigh Valley, PA 18001	do	Lehigh and York.
Perlite Manufacturing Co	Box 478 Carnegie, PA 15106	do	Allegheny.
Sand and gravel:			
Davison Sand & Gravel Co	3d Ave. and 4th St. New Kensington, PA 15068	Dredge	Westmoreland.
Dravo Corp	One Oliver Plaza Pittsburgh, PA 15222	do	Beaver.
Erie Sand Steamship Co	Erie, PA 16500	do	Erie.
Shippingport Sand & Gravel Co	1200 Stambaugh Bldg. Youngstown, OH 44503	Pit	Armstrong.
Warner Co.[1,4,5]	1721 Arch St. Philadelphia, PA 19103	Pit	Bucks.
Slag:			
Bethlehem Mines Corp.[1,4]	701 East 3d St. Bethlehem, PA 18016	Plant	Cambria.
Dunbar Slag Co.	Box 666 Sharon, PA 16146	do	Mercer.

See footnotes at end of table.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Slag —Continued			
Standard Slag Co	1200 Stambaugh Bldg. Youngstown, OH 44503	Plant	Cambria.
Stone:			
G. & W. H. Corson, Inc.[4]	Plymouth Meeting, PA 19462	Quarry	Montgomery.
The General Crushed Stone Co	712 Drake Bldg. Easton, PA 18042	do	Bucks, Chester, Delaware, Lancaster, Luzerne, Perry.
Glasgow Quarry, Inc	Route 2, Box 121 Glasgow, MO 65254	do	Montgomery.
Martin-Marietta Corp	11300 Rockville Pike Rockville, MD 20852	do	Centre, Chester, Fayette, Northampton.
New Enterprise Stone & Lime Co., Inc	New Enterprise, PA 16664	do	Bedford, Blair, Cumberland, Franklin, Huntingdon, Somerset.
Sulfur:			
Atlantic Richfield Co	3144 Passyunk Ave. Philadelphia, PA 19145	Plant	Philadelphia.
British Petroleum Corp., Ltd	Box 428 Marcus Hook, PA 19061	do	Delaware.
Gulf Oil Corp	Box 7408 Philadelphia, PA 19101	do	Philadelphia.
Tripoli:			
Keystone Filler & Manufacturing Co	Muncy, PA 17756	Pit	Lycoming.
Vermiculite, exfoliated:			
Hyzer & Lewellen, Inc	Box 155 Southampton, PA 18966	Plant	Bucks.
W. R. Grace & Co	62 Whittemore Ave. Cambridge, MA 02140	do	Lawrence.

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[1] Also stone.
[2] Also clays.
[3] Also expanded perlite.
[4] Also lime.
[5] Also slag.

The Mineral Industry of Puerto Rico, the Virgin Islands, and Pacific Island Possessions

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Department of Natural Resources of the Commonwealth of Puerto Rico for collecting information on all nonfuel minerals.

By Doss H. White, Jr.[1] and John W. Sweeney[2]

PUERTO RICO

Mineral production in Puerto Rico in 1978 and 1979 added $132.9 million and $135.5 million, respectively, to the Island's economy. Puerto Rican nonfuel mineral production was restricted primarily to minerals used directly or indirectly in construction.

Trends and Developments.—The construction industry in Puerto Rico experienced a decline in activity from 1974 through 1977. Conditions improved in 1978 when construction permits increased 23% to a total value of $444 million. As a result, construction employment and sales of construction materials showed positive signs of recovery for the first time since the recession began. In 1978, production of all mineral commodities increased, with the exception of salt, which remained the same as in the previous year.

Table 1.—Nonfuel mineral production in Puerto Rico[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement, portland thousand short tons	1,367	$67,775	1,442	$78,981	1,406	$70,197
Clays do	272	387	286	544	260	556
Lime do	40	3,007	41	3,249	37	3,307
Salt do	27	639	27	639	27	639
Sand and gravel do	[e]12,000	[e]21,000	NA	NA	NA	NA
Stone:						
Crushed do	12,043	42,648	13,765	47,611	14,747	59,733
Dimension do	144	1,633	143	1,898	79	1,105
Total	XX	137,089	XX	[2]132,922	XX	[2]135,537

[e]Estimate. NA Not available. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Total does not include value of items not available.

Table 2.—Value of nonfuel mineral production in Puerto Rico, by district

(Thousands)

District	1977	1978	Minerals produced in 1978 in order of value
Aguadilla	$981	W	Stone.
Arecibo	W	W	Do.
Humacao	W	W	Do.
Mayaguez	2,781	$2,864	Stone and salt.
Ponce	W	W	Cement, lime, stone, clays.
San Juan	W	W	Cement, stone, clays.
Undistributed[1]	133,324	130,057	
Total[2]	137,089	[3]132,922	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes some stone and sand and gravel (1977) that cannot be assigned to specific districts, and values indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

[3] Incomplete total, excludes value of sand and gravel.

The upward trend continued through the first quarter of 1979. However, severe rains from mid-April through September severely hampered construction when rainfall exceeded the average annual rate by 51%. The Island was hit by two hurricanes in August, seriously disrupting construction activities. In October, a strike by independent truckers that lasted 5 weeks virtually paralyzed the Island's construction industry The weather conditions and truckers' strike created a $160 million backlog in construction.

The development of the Utado-Adjuntas-Lares porphyry copper deposits of west-central Puerto Rico continued to be of prime interest to the Commonwealth. Discussions between Government representatives and the Kennecott Copper Corp.-AMAX partnership through 1979 did not significantly change the basic technical proposals; however, allocation of revenues among the companies and the Commonwealth was a major point of concern. The deposits collectively contain about 250 million short tons of ore averaging 0.7% copper. The average annual output of refined copper over a 30-year mine life would be over 58,000 tons with significant recovery of byproduct silver, gold, and sulfuric acid.

Estimates of development costs prepared by the Commonwealth in September 1977 indicated that the total capital investment for the project would be approximately $500 million. About 2,000 persons would be employed in the first 3-year development stage. Later, 800 to 1,000 persons would be employed annually.

The Commonwealth and Universal Oil Products Co. (UOP) continued an evaluation of the Guanajibo nickel laterites near Mayaguez. In 1978, bulk samples were sent to UOP's facilities in Tucson, Ariz., for further metallurgical testing. In addition, a small sample was sent to the Federal Bureau of Mines Metallurgy Research Center at Albany, Oreg., for evaluation using a Bureau-developed recovery process. The reserves are estimated at 200 million tons at a grade of 0.9% nickel and 0.09% cobalt. At the end of 1979, no decision had been reached on development.

Legislation and Government Programs.—The U.S. Department of Commerce accepted Puerto Rico's Coastal Zone Management Program. It cited the program as a model tailored to meet the Island's problems, and allocated a $1,474,000 grant for program management.

In 1978 and 1979, the Puerto Rican Department of Natural Resources and the U.S. Geological Survey investigated offshore sand deposits. Bulk samples for four potential offshore sand deposits were sent to the Puerto Rico Highway Authority to determine suitability for making concrete. Investigation continued on the resources and environmental consequences of sand recovery in the Cabo Rojo area.

The Puerto Rican Government, through its Department of Natural Resources, collected a royalty for sand and gravel produced from public lands. These royalty assessments are $0.45 per cubic meter for sand and gravel, $0.75 per cubic meter for unprocessed river-run sand, and $0.20 per cubic meter for fill material. A $250 annual extraction permit was required from all operations extracting sand and gravel from either public or private lands. The royalty payment through December 1978 was $129,320.

REVIEW BY NONFUEL MINERAL COMMODITIES

Cement.—The Puerto Rican Cement Co., Inc., at Ponce and the San Juan Cement Co., Inc., at Dorado produced portland cement using the wet grinding process.

Although the value of cement sales in 1979 exceeded that of 1978, production declined because of the decreased activity in the construction industry. This was caused by abnormal weather conditions and a truckers' strike, resulting in a drop in sales of over 1.5 million bags of cement.

Table 3.—Puerto Rico: Portland cement salient statistics

(Short tons)

	1978	1979
Number of active plants	2	2
Production	1,495,207	1,412,769
Shipments from mills:		
Quantity	1,441,626	1,406,214
Value	$78,981,428	$70,197,172
Stocks at mills, Dec. 31	30,657	37,212

Clays.—In 1978 and 1979, the Puerto Rican Cement Co., Inc., and the San Juan Cement Co., Inc., produced common clay for use in cement manufacturing.

Graphite.—Union Carbide Corp. manufactured synthetic graphite electrodes at the Yabucoa facility from petroleum coke obtained from the company's Penuelas operation.

Lime.—Chemical grade lime was produced by the Puerto Rican Cement Co., Inc., at the Ponce facility. The lime was marketed in Puerto Rico and the Virgin Islands primarily for water purification, sugar refining, and S-type mason's lime for construction and plastering in tropical climates.

Salt.—Three companies recovered salt from the solar evaporation of seawater. Production for the 2-year period remained about the same as in previous years.

Sand and Gravel.—Sand and gravel was produced for construction purposes by commercial and Government operators.

Stone.—In 1978 and 1979, the stone industry produced crushed limestone, marble, traprock, and granite for road building, concrete aggregate, and other construction-related uses.

Sulfur.—Commonwealth Oil Refining Co. and Puerto Rico Sun Oil Co. recovered elemental sulfur as a byproduct of oil refining.

Table 4.—Puerto Rico: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	--	--	--	--	49	106
Concrete aggregate	[r]1,027	[r]2,673	1,340	3,504	1,229	3,739
Bituminous aggregate	202	607	232	694	444	1,729
Macadam aggregate	W	W	28	65	23	50
Dense-graded roadbase stone	180	403	270	639	211	650
Other construction aggregate and roadstone	7,721	33,678	8,849	37,281	9,823	47,233
Manufactured fine aggregate (stone sand)	[r]17	[r]44	--	--	W	W
Terrazzo and exposed aggregate	57	281	76	423	48	445
Other uses[2]	2,839	4,962	2,970	5,003	2,919	5,781
Total[3]	12,043	42,648	13,765	47,611	14,747	59,733

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, marble, and traprock.

[2] Includes stone used for surface treatment aggregate, filter stone (1979), cement manufacture, lime manufacture, asphalt filler (1977 and 1979), and roofing granules.

[3] Data may not add to totals shown because of independent rounding.

VIRGIN ISLANDS

The U.S. Virgin Islands, purchased from Denmark in 1917 for $25 million, are part of the Antilles, which form the boundary between the Caribbean Sea and the Atlantic Ocean. The island group, located about 34 miles east of Puerto Rico, consists of 3 large and 62 small islands covering an area of 133 square miles. The three main islands, St. Croix, St. Thomas, and St. John, dominate the commercial activity of the group.

Basalt (traprock), crushed for use as concrete aggregate and roadstone, was the primary mineral commodity produced. Two companies, Caribbean Materials Supply Co. and St. Croix Stone and Sand Co., accounted for the total production.

Martin Marietta Aluminum Co. continued work on expanding the St. Croix alumina facility. When completed, plant capacity will increase from 550,000 to 700,000 tons per year. The plant uses bauxite from Guinea to produce alumina, which was imported by aluminum producers in the United States, Norway, and the Soviet Union.

PACIFIC ISLAND POSSESSIONS

American Samoa.—American Samoa consists of Tutuila, Swains, and five smaller islands approximately 3,500 miles west of Australia and 2,200 miles southwest of Hawaii. About 80% of the 31,000 Samoans live on Tutuila, the principal island in the group. Virtually all of the mineral production, restricted to volcanic cinder and coral, was from Tutuila Island.

Guam.—Located at the southern end of the Mariana chain, 1,500 miles north of New Guinea, Guam is the largest island in the group. The northern half of the island is an elevated coral and limestone plateau, while the southern half is underlain by volcanic rock. Guam has an area of 209 square miles and a population of approximately 100,000. Crushed stone was the major mineral commodity produced in 1978 and 1979. During this period, Hawaiian Rock Products Co., Perez Bros., Inc., Pacific Rock Corp., and the Guam Department of Public Works produced crushed limestone from six quarries. This material was utilized domestically by the construction industry.

TRUST TERRITORY OF THE PACIFIC ISLANDS

This Territory comprises about 2,000 islands with a land area of 1,335 square miles. The islands, commonly called Micronesia, were transferred to United States stewardship by the United Nations in 1947 under an agreement that will expire in 1981. In 1975, the Northern Mariana Islands voted to leave the Trust Territory and become a United States commonwealth. This status, achieved in January 1978, grants increased self-government, but retains protection by the United States. The 14 islands comprising the Northern Marianas have a land area of 182 square miles and a population estimated at over 16,000, with the majority concentrated on Saipan Island.

The Japanese controlled the Territory from 1919 until 1945 and were active in mineral exploration and the mining of bauxite, manganese, and phosphate. In recent years, mineral production has been restricted to construction materials such as volcanic rock, limestone, sand, and coral. Aggregate shipments are common between islands, because some of them are deficient in aggregate material.

Free Public Library, Newark, N. J.

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The Mineral Industry of Rhode Island

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Rhode Island Department of Natural Resources, for collecting information on all nonfuel minerals.

By Doss H. White, Jr.[1]

The value of nonfuel mineral production in Rhode Island in 1978 and 1979 added $7.5 million and $7.9 million, respectively, to the economy of the State. In terms of value, over 90% of the State's mineral production was sand and gravel, which was used primarily by the construction industry.

Trends and Developments.—Except for some construction materials, the nonfuel mineral requirements of Rhode Island's industry were imported. This included all metals and most chemical and industrial materials. Of approximately 300,000 industrial workers in the State, only 300-400 were directly engaged in mineral extraction. However, approximately 11,000 were employed in the mineral-dependent construction industry, and 25,000 were employed in processes or manufacturing that involved stone, clay, glass, primary metals, and fabricated metal products. An additional 32,000 workers were associated with industries that relied upon mineral-derived materials.

From 1970 through 1979, value of the State's mineral production increased more than 40%. Gains were recorded for all years except 1971-1972 and 1977. The decrease in value of mineral production in 1971 and 1972 reflected reductions in the mineral industries of five other New England States, which were caused by recessionary pressures on the region's economy. The slight drop in value in 1977 was due to a decrease in sand and gravel sales in Kent County.

Table 1.—Value of nonfuel mineral production in Rhode Island, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Kent	$1,576	$1,761	Sand and gravel.
Newport	W	W	Stone, sand and gravel.
Providence	W	W	Sand and gravel, stone.
Washington	1,804	2,666	Sand and gravel.
Undistributed[2]	2,919	3,065	
Total[3]	6,299	7,493	

W Withheld to avoid disclosing company proprietary data; included in "Undistributed."

[1] Bristol County is not shown because no nonfuel mineral production was reported.

[2] Includes gem stones and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 2.—Indicators of Rhode Island business activity

	1977	1978	1979^p	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force ________ thousands__	441.0	432.0	450.0	+4.2
Unemployment________________do____	38.0	29.0	30.0	+3.4
Employment (nonagricultural):				
Mining ___________________do____	([1])	([1])	([1])	--
Manufacturing ______________do____	128.8	134.4	132.3	-1.6
Contract construction __________do____	12.6	13.5	13.6	+.7
Transportation and public utilities _do____	13.3	13.3	13.5	+1.5
Wholesale and retail trade _______do____	77.4	79.4	81.1	+2.1
Finance, insurance, real estate____do____	19.1	20.0	20.9	+4.5
Services __________________do____	[2]72.3	[2]75.4	[2]79.0	+4.8
Government ________________do____	58.2	59.8	59.8	--
Total nonagricultural employment _do____	381.7	395.8	[3]400.0	+1.1
Personal income:				
Total ____________________ millions__	$6,310	$6,960	$7,679	+10.3
Per capita ________________________	$6,731	$7,447	$8,266	+11.0
Construction activity:				
Number of private and public residential units authorized ______________________	5,301	[4]5,446	5,327	-2.2
Value of nonresidential construction _ millions__	$56.3	$59.0	$64.2	+8.8
Value of State road contract awards ___do____	$16.0	NA	NA	--
Shipments of portland and masonry cement to and within the State _ thousand short tons__	144	165	165	--
Nonfuel mineral production value:				
Total crude mineral value ________ millions__	$6.3	$7.5	$7.9	+5.3
Value per capita, resident population ______	$7	$8	$8	--
Value per square mile_________________	$5,189	$6,172	$6,496	+5.2

^pPreliminary. NA Not available.
[1] Included with "Services."
[2] Includes mining.
[3] Data do not add to total shown because of independent rounding.
[4] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Legislation and Government Programs.—The 1979 Rhode Island Legislature passed a Uniform Blasting Law giving control over explosives and blasting to the State Fire Marshall. The bill's standards for distance and size of explosive charges were those recommended by the Federal Bureau of Mines. The bill was opposed in Cumberland Hill where residents, concerned with blasting operations at a local quarry, wanted local control over blasting activity.

Rhode Island's coastal zone management program was approved by the Office of Coastal Zone Management. The Federal Coastal Zone Management Act, passed in 1972, provides States along the coast with the opportunity and financial means to establish comprehensive management programs for their shorelines. Mineral development in the coastal zone would be regulated by this program.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Since Rhode Island has no cement-producing plants, cement is imported from other northeastern States. Shipments into the State during the biennium totaled 318,000 tons of portland-type and 11,000 tons of masonry-type cement, which was used mostly in construction.

Sand and Gravel.—During 1978 and 1979, Rhode Island's sand and gravel industry comprised 25 companies operating 25 pits in 4 counties. In 1978, Washington County was the leading producer, accounting for approximately 36% of the tonnage; however, in 1979, Providence County led with 49% of the State's production. Principal uses were asphalt and concrete aggregate, concrete products, roadbase, and fill.

The State purchased 13,000 acres along the Big River and Wood River to construct a water storage reservoir. Design studies for the reservoir were financed, in part, by $500,000 from the sale of sand and gravel produced from the acquired land.

Block Island, off the southwestern coast of Rhode Island, was the site of a 13-mile road paving and an airport runway resurfacing project during 1978. Sand and gravel for 45,000 tons of bituminous concrete used in the project was barged to the island from suppliers located along the southeastern New England coast.

Table 3.—Rhode Island: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	615	$1,294	$2.10	773	$1,852	$2.39	709	$1,620	$2.29
Plaster and gunite sands	NA	NA	NA	W	W	W	25	100	4.00
Concrete products	363	726	2.00	W	W	W	W	W	W
Asphaltic concrete	588	1,240	2.11	667	1,930	2.60	619	1,702	2.75
Roadbase and coverings	630	1,074	1.71	724	1,276	1.76	606	1,135	1.87
Fill	676	726	1.07	407	456	1.12	1,180	1,338	1.13
Snow and ice control	NA	NA	NA	W	W	W	W	W	W
Total[1] or average	2,872	5,060	1.76	2,978	6,176	2.07	3,537	6,737	1.90

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Table 4.—Rhode Island: Construction sand and gravel sold or used by producers

	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	1,200	$2,232	$1.86	1,419	$2,947	$2.08	1,287	$2,232	$1.73
Gravel	1,673	2,828	1.69	1,559	3,229	2.07	2,250	4,505	2.00
Total[1] or average	2,872	5,059	1.76	2,978	6,176	2.07	3,537	6,737	1.90

[1] Data may not add to totals shown because of independent rounding.

Stone.—The State's stone industry was composed of four companies producing marble, limestone, granite, and quartzitic graywacke. Marble mined and crushed by The Conklin Limestone Co., Inc., Ashton, was sold for rubble, agricultural limestone, terrazzo, roofing granules, filler, and flux. M.A. Gammino Construction Co., Cranston, produced crushed granite, which was used for bituminous and concrete aggregate, roadbase, riprap, railroad ballast, and filter stone. Graywacke was crushed by Peckham Brothers Co., Inc., from a quarry near Middletown for asphalt aggregate and roadbase use. Granite riprap was produced by Gerald T. Kidd, Inc., from a quarry near Tiverton.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

Table 5.—Rhode Island: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate	[r]23	W	27	W	33	W
Bituminous aggregate	106	W	110	W	34	W
Macadam aggregate	6	22	--	--	--	--
Dense-graded roadbase stone	21	W	W	W	W	W
Riprap and jetty stone	W	W	29	W	14	47
Railroad ballast	--	--	1	W	--	--
Filter stone	10	W	54	W	41	W
Other uses[2]	46	1,217	41	1,316	104	1,101
Total[3]	274	1,238	300	1,316	249	1,148

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, and other stone.

[2] Includes stone used in agricultural limestone, surface treatment aggregate (1978), other construction aggregate and roadstone (1979), flux stone, other fillers or extenders, roofing granules, fill (1977), and data indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 6.—Principal producers

Commodity and company	Address	Type of activity	County
Sand and gravel:			
A. Cardi Construction Co., Inc	451 Arnold Rd. Coventry, RI 02816	Pit	Kent.
J. H. Lynch & Sons, Inc	Box 325 Ashton, RI 02816	Pit	Providence.
Material Services, Inc	Greenville Rd. North Smithfield, RI 02895	Pit	Do.
V. J. Paolino Construction Co	Box 383 Slatersville, RI 02876	Pit	Do.
Rhode Island Sand & Gravel Co., Inc.	Kilvert St. Warwick, RI 02886	Pit	Kent.
River Sand & Gravel Co	221 Benedict St. Pawtucket, RI 02864	Pit	Washington.
South County Sand & Gravel Co., Inc.	North Rd. Peace Dale, RI 02878	Pit	Do.
Tasca Sand & Gravel Co	Box 113, RFD 4 Esmond, RI 02917	Pit	Providence.
Stone:			
Granite and other stone:			
M. A. Gammino Construction Co.	875 Phenix Ave. Cranston, RI 02840	Quarry	Do.
Gerald T. Kidd, Inc	67 Riverside Dr. Tiverton, RI 02878	do	Newport.
Peckham Bros. Co., Inc	Box 193 Newport, RI 02840	do	Do.
Limestone, crushed:			
The Conklin Limestone Co., Inc.	RFD 1 Lincoln, RI 02860	do	Providence.

The Mineral Industry of South Carolina

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of Interior, and the South Carolina Geological Survey, State Division of Research and Statistical Services, for collecting information on all nonfuel minerals.

By James R. Boyle[1] and Norman K. Olson[2]

The value of nonfuel mineral production in South Carolina was $182.8 million in 1978 and $201.7 million in 1979. Cement, stone, clays, and sand and gravel were the major contributors to total production value. In 1978, the production of all mineral commodities except dimension stone increased over that of the previous year. Most commodities also increased in unit value, but notable exceptions were manganiferous ore, peat, and fuller's earth. South Carolina ranked second nationally in the production of kaolin, flake mica, and vermiculite; sixth in masonry cement; eighth in fuller's earth; and ninth in common clay and industrial sand and gravel.

Mineral commodities were produced in 40 of the 46 counties. Aiken County led in the number of operating mines with 31, followed by Cherokee with 24 and Lexington with 21.

Trends and Developments.—Alumax, Inc., a joint venture of AMAX Inc. and Mitsui & Co., continued construction of its

Table 1.—Nonfuel mineral production in South Carolina[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:						
Portland thousand short tons	W	W	W	W	1,831	$79,377
Masonry do	W	W	W	W	W	W
Clays[2] do	2,172	$18,705	2,358	$22,538	2,272	24,492
Gem stones	NA	4	NA	5	NA	5
Manganiferous ore thousand short tons	20	W	22	W	26	W
Mica (scrap) do	43	589	49	782	47	770
Peat do	16	W	16	W	W	W
Sand and gravel do	7,766	19,281	8,344	22,530	8,321	26,665
Stone:						
Crushed do	14,772	36,043	16,997	44,237	16,589	48,352
Dimension do	13	627	10	567	9	482
Combined value of clays (fuller's earth), vermiculite, and values indicated by symbol W	XX	68,952	XX	92,142	XX	21,568
Total	XX	144,201	XX	182,801	XX	201,711

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fuller's earth; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in South Carolina, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Aiken	$14,366	$17,100	Clays, sand and gravel.
Anderson	W	W	Stone, sand and gravel.
Bamberg	70	115	Sand and gravel.
Berkeley	3,184	W	Stone.
Charleston	606	283	Sand and gravel.
Cherokee	3,424	4,185	Stone, clays, sand and gravel, mica, manganiferous ore.
Chester	W	W	Sand and gravel.
Chesterfield	W	W	Sand and gravel, stone.
Clarendon	140	140	Sand and gravel.
Colleton	W	W	Sand and gravel, peat.
Dillon	84	W	Sand and gravel.
Dorchester	36,670	50,849	Cement, stone, clays, sand and gravel.
Edgefield	76	17	Clays.
Fairfield	W	W	Stone.
Florence	1,028	1,001	Sand and gravel.
Georgetown	W	W	Stone, sand and gravel.
Greenville	W	W	Do.
Greenwood	W	W	Stone, clays, sand and gravel.
Horry	W	W	Sand and gravel, stone, clays.
Jasper	W	W	Sand and gravel.
Kershaw	W	W	Sand and gravel, clays, stone.
Lancaster	W	W	Mica, sand and gravel, clays.
Laurens	W	W	Vermiculite, stone.
Lexington	W	W	Sand and gravel, stone, clays.
Marion	W	W	Clays, sand and gravel.
Marlboro	W	W	Sand and gravel, clays.
Newberry	32	52	Clays.
Oconee	163	368	Stone.
Orangeburg	29,251	38,752	Cement, stone, clays, sand and gravel.
Pickens	W	W	Stone.
Richland	W	W	Stone, clays, sand and gravel.
Saluda	6	52	Clays.
Spartanburg	W	W	Stone, sand and gravel.
Sumter	W	2,820	Sand and gravel, clays.
Union	W	W	Sand and gravel.
York	W	W	Stone, sand and gravel, clays.
Undistributed[2]	55,099	67,069	
Total[3]	144,201	182,801	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] The following counties are not listed because no nonfuel mineral production was reported: Abbeville, Allendale, Barnwell, Beaufort, Calhoun, Darlington, Hampton, Lee, McCormick, and Williamsburg.

[2] Includes gem stones and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

$400 million aluminum-reduction plant in Berkeley County. The plant, with a planned capacity of 197,000 tons per year, was scheduled for completion in 1980 and was expected to be operating at full capacity in 1981. Alumax planned to import alumina from Australia through the port of Charleston in monthly shipments of about 30,000 to 40,000 tons each. It was projected that the plant will require 350 megawatts of electricity, and plans were for South Carolina Public Service Authority (Santee Cooper) to supply this electricity from its expanded Winyah Electric Generating Station near Georgetown. Of the total investment, Alumax expected to spend approximately $40 million on pollution control equipment.

Nassau Recycle Corp. was investing $50 million in a new recycling facility south of Columbia near Gaston. The facility was planned as a center to recycle copper and other metals for the Bell Telephone system.

Legislation and Government Programs.—A South Carolina Mapping Advisory Committee was established to consider and report Statewide mapping needs. The 22-member committee, composed of representatives from the public and private sectors, was expected to consolidate Statewide mapping requirements into an annual report to the U.S. Geological Survey (USGS), develop standards for mapping in the State, eliminate unnecessary duplication of mapping efforts, and develop Statewide support for coordinated and cost-effective financing of mapping programs.

The USGS and the Federal Bureau of Mines conducted a study of a 1,500-acre area in the Wambaw Swamp in eastern South Carolina that was proposed for designation as a Federal wilderness area. Although phosphate, uranium, peat, sand, heavy minerals, and clay exist within the study area, the area has a low potential for mineral development because these minerals are present only in limited amounts. In addition, the phosphate and uranium in the area are of considerably lower grade than that presently being mined elsewhere in the United States.

Free Public Library, Newark, N. J.

Table 3.—Indicators of South Carolina business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	1,280.0	1,290.0	1,306.0	+1.2
Unemployment do	92.0	74.0	65.0	-12.2
Employment (nonagricultural):				
Mining do	1.8	1.8	1.9	+5.6
Manufacturing do	380.2	391.1	399.3	+2.1
Contract construction do	65.8	70.2	72.8	+3.7
Transportation and public utilities do	45.1	48.8	53.3	+9.2
Wholesale and retail trade do	199.5	213.0	223.0	+4.7
Finance, insurance, real estate do	41.5	43.8	46.6	+6.4
Services do	134.1	145.0	152.6	+5.2
Government do	213.7	223.8	228.4	+2.1
Total nonagricultural employment do	1,081.7	1,137.5	[1]1,177.8	+3.5
Personal income:				
Total millions	$16,260	$18,357	$20,605	+12.2
Per capita	$5,651	$6,292	$7,027	+11.7
Construction activity:				
Number of private and public residential units authorized	22,139	[2]27,022	25,655	-5.1
Value of nonresidential construction millions	$135.8	$134.7	$274.6	+103.9
Value of State road contract awards do	$120.1	$69.0	$93.7	+35.8
Shipments of portland and masonry cement to and within the State thousand short tons	988	1,080	1,049	-2.9
Nonfuel mineral production value:				
Total crude mineral value millions	$144.2	$182.8	$201.7	+10.3
Value per capita, resident population	$50	$63	$69	+9.5
Value per square mile	$4,643	$5,886	$6,495	+10.3

[p] Preliminary.

[1] Data do not add to total shown because of independent rounding.

[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

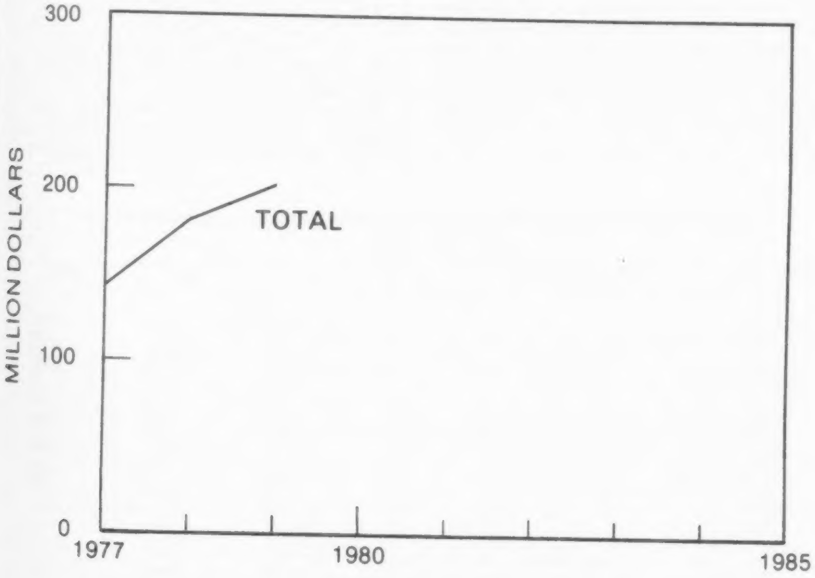

Figure 1.—Total value of nonfuel mineral production in South Carolina.

Mineral-related activities in South Carolina's coastal zone are regulated under the State's Coastal Zone Program. In 1979, South Carolina became the second State in the Coastal Plains Region to receive Federal approval for its coastal management program. The State program established a permitting process for activities occurring in critical areas of the coastal zone, including tidelands, coastal waters, beaches, and primary oceanfront sand dunes.

The Division of Mining and Reclamation of the South Carolina Land Resources Conservation Commission conducted a Statewide inventory of abandoned mine lands to determine if land use and/or environmental problems exist. The inventory was concerned only with mines abandoned prior to July 1, 1974, when the South Carolina Mining Act took effect.

The South Carolina Geological Survey, formerly a division of the South Carolina Development Board, transferred in August 1979 to a new parent agency, the Division of Research and Statistical Services, under the State Budget and Control Board. The Survey, as in the past, continued its basic geologic and mineral resources programs. Significant publications during 1978 and 1979 were Geologic Map of South Carolina, Bibliography and Index of South Carolina Geology Through 1977, Mineral Resources and Mineral Industries Map of South Carolina (revised), Earthquake History of South Carolina, Aiken County and Lexington County Geologic Mapping, and Chesterfield County Economic Sand Study.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Cement continued to rank first in production value among South Carolina's mineral commodities. The quantity and value of both portland and masonry cement output in 1978 increased significantly over that of 1977, but production of both declined in 1979. Portland cement was produced in southern South Carolina by Giant Portland and Masonry Cement Co. and Gifford-Hill & Co., Inc., in Dorchester County and Santee Portland Cement Corp. in Orangeburg County. Giant and Santee also produced masonry cement. Each company mined marl and miscellaneous clays as raw materials in the manufacture of cement. Other raw materials used were sand, iron ore, fly ash, and gypsum. Most of the portland cement shipped was type I or type II. Principal uses were in building material and concrete products, ready-mix concrete, and highway construction. In 1979, Santee was sold to Dundee Cement Co. of Dundee, Mich. Dundee is part of the Hollerbank Group, a Swiss corporation.

Clays.—Clay production included processed kaolin, miscellaneous clays used for the manufacture of brick and cement, and

Table 4.—South Carolina: Kaolin sold or used by producers, by kind and use

(Short tons)

Kind and use	1977	1978	1979
Airfloat:			
Adhesives	18,814	18,020	19,937
Animal feed and pet absorbent	23,410	1,941	2,595
Ceramics[1]	18,409	31,998	20,912
Fertilizers	12,170	17,674	16,564
Fiberglass	77,139	91,631	96,256
Paint	1,644	934	747
Paper filling	4,389	5,120	4,519
Pesticides and related products	16,181	18,259	23,059
Plastics	11,614	8,190	9,310
Rubber	237,377	255,990	244,098
Other refractories[2]	6,541	8,509	8,514
Other uses[3]	6,023	8,207	4,233
Exports[4]	55,256	66,613	71,518
Total	488,967	531,163	522,262
Unprocessed: Face brick; firebrick, block, and shapes	234,568	253,475	244,714
Grand total	723,535	784,638	766,976

[1] Includes floor and wall tile (1978-79), pottery, quarry tile (1977), roofing granules, sanitary ware, and miscellaneous.

[2] Includes high-alumina refractories, refractory mortar and cement, foundry sand (1978), refractory grogs and crudes, and miscellaneous.

[3] Includes common brick, crockery and other earthenware, drilling mud (1979), asphalt and roof tile, and ink.

[4] Includes ceramics, pesticides and related products, rubber, and miscellaneous.

fuller's earth used as an absorbent. In 1978, clays were mined by 24 companies at 50 pits in 17 counties. Leading producers were Richtex Corp., Southern Brick Co., Giant Portland and Masonry Cement Co., Gifford-Hill & Co., Inc., and Palmetto Brick Co.

South Carolina ranked second in the Nation in the production of kaolin. Processed kaolin was produced in Aiken, Kershaw, Lexington, and Richland Counties by five firms operating six mines. Airfloated kaolin was used principally in rubber products, paints, high-quality paper, fertilizers, and pesticides. Water-washed kaolin produced at one plant near the North Edisto River was sold for filling and paper coating. Unprocessed kaolin was used in manufacturing refractories, in brick as a colorant, and in the manufacture of cement. Kaolin was also mined in several other counties along a line extending through the cities of Aiken, Columbia, and Cheraw for use in brick manufacture.

Miscellaneous clay was produced from 43 mines in 17 counties and was used almost entirely in the manufacture of brick.

Fuller's earth was produced by one operator in Sumter County and sold chiefly for use in various oil, grease, and pet products. Fuller's earth is a light-colored opaline claystone, which after being calcined at high temperatures has great absorptive capacities for oils, odor, and water.

Colemanite.—Industrial Minerals, Inc., York, S.C., processed colemanite (calcium borate) ore imported from Turkey at its York County plant. The ore was ground, dried and shipped to Pittsburgh Plate Glass Industries, Inc., and to Owens-Corning Fiberglas Corp. for use in glass fibers.

Feldspar.—Spartan Minerals Co., a division of Lithium Corp. of America, produced a feldspar-silica mixture from tailings shipped to Pacolet from the Lithium Corp.'s spodumene operation in North Carolina. The mixture was sold for use in manufacturing glass containers, in ceramic whiteware, and as latex filler. No feldspar was being mined in South Carolina.

Mica (Sericite).—Four mines in Lancaster and Cherokee Counties produced crude mica. Sericite was dry-milled to produce a micaceous product that was sold mainly for use as an inert filler in paint, expansion-joint cement, and in electronics. South Carolina ranked second in the Nation in the production of crude mica.

Peat.—Crude peat was mined by United States Peat Corp. from a bog near Green Pond, Colleton County. The peat was mixed with special additives at the company's processing plant, bagged, and shipped for use in general soil improvement.

Sand and Gravel.—In 1978, sand and gravel was mined by 66 companies at 75 pits in 28 counties. Leading producing counties were Lexington, with 10 pits; Marlboro, with 2 pits; and Sumter, with 3 pits.

Sand and gravel was used mainly as aggregate in concrete and asphalt and as fill. Industrial sand was used primarily in glassmaking, sandblasting, foundry, and filtration applications. Most of the State's sand and gravel in 1978 was shipped by truck (78.7%).

Table 5.—South Carolina: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	2,709	$5,942	$2.19	3,029	$6,543	$2.16	3,119	$7,655	$2.45
Plaster and gunite sands	NA	NA	NA	W	W	1.91	W	W	3.67
Concrete products	473	995	2.10	462	1,184	2.56	457	1,144	2.50
Asphaltic concrete	1,525	3,126	2.05	1,894	4,758	2.51	1,842	4,837	2.63
Roadbase and coverings	381	646	1.70	W	W	1.63	339	514	1.51
Fill	1,193	1,330	1.11	1,181	1,321	1.12	1,354	1,682	1.24
Snow and ice control	NA	NA	NA	W	W	2.00	W	W	2.25
Railroad ballast	W	W	1.00	26	27	1.03	26	27	1.03
Other uses	W	W	1.33	167	256	1.53	118	136	1.15
Total[1] or average	6,877	12,823	1.86	7,459	15,360	2.06	7,332	16,273	2.22

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Table 6.—South Carolina: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	5,563	$8,727	$1.57	5,662	$9,430	$1.67	5,535	$9,825	$1.78
Gravel	1,314	4,096	3.12	1,798	5,926	3.30	1,797	6,448	3.59
Total[1] or average	6,877	12,823	1.86	7,459	15,360	2.06	7,332	16,273	2.22
Industrial:									
Sand	888	6,458	7.27	W	W	8.18	W	W	10.50
Gravel	--	--	--	W	W	5.75	W	W	6.32
Total or average	888	6,458	7.27	885	7,173	8.11	989	10,392	10.51
Grand total[1] or average	7,766	19,281	2.48	8,344	22,530	2.70	8,321	26,665	3.20

W Withheld to avoid disclosing company proprietary data; included with "Total."

[1] Data may not add to totals shown because of independent rounding.

Stone.—The value of the State's stone production continued to rank second behind that of cement In 1978, crushed stone production increased over that of 1977 in tonnage, value, and unit value. The production of dimension stone, however, decreased in tonnage and value, but its unit value increased.

Limestone, granite, and marl were mined for use as crushed stone. Granite was also mined for use as dimension stone. In 1978, stone was produced by 18 companies from 35 quarries in 18 counties. Granite was produced by 12 companies from 26 quarries in 14 counties; limestone by 6 companies from 7 quarries in 5 counties; and marl by 2 companies from 2 quarries in 1 county. Dimension granite was produced by Granite Quarry Corp., a division of Matthews International Corp.; Winnsboro Granite Corp.; and Comolli Granite Co. from four quarries in Fairfield and Kershaw Counties.

In 1978, 91% of the State's crushed stone tonnage was produced by the 7 largest producing companies from 22 quarries. Crushed stone was shipped by truck (80.1%), railroad (7.6%), and by other means (12.3%). Leading producing counties were Richland, Pickens, Berkeley, Spartanburg, and Orangeburg. The leading producers were Vulcan Materials Co., with five quarries, Martin Marietta Aggregates, with eight quarries; and Lone Star Industries, with five quarries.

Table 7.—South Carolina: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	487	2,138	478	2,486	347	1,936
Concrete aggregate	[r]2,443	[r]6,750	2,571	7,582	2,547	8,255
Bituminous aggregate	1,603	4,125	2,026	5,567	1,804	5,563
Macadam aggregate	407	1,078	341	896	382	1,044
Dense-graded roadbase stone	3,623	8,806	4,685	12,587	2,753	8,081
Surface treatment aggregate	W	W	W	W	319	1,003
Other construction aggregate and roadstone	3,059	7,986	2,554	6,825	4,445	13,991
Riprap and jetty stone	W	W	164	521	179	612
Railroad ballast	332	859	459	1,212	479	1,483
Manufactured fine aggregate (stone sand)	350	911	493	1,280	633	2,007
Cement manufacture	2,198	2,621	2,768	3,861	2,667	4,300
Other uses[2]	268	770	458	1,420	35	75
Total[3]	14,772	36,043	16,997	44,237	16,589	48,352

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, and marl.

[2] Includes stone used in asphalt filler (1978-79), filter stone (1978), sulfur dioxide (1978-79), and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

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Vermiculite.—The Nation's crude vermiculite is produced in Montana, South Carolina, and Tennessee. Production in South Carolina increased in 1978, as did unit value. In 1979, production stabilized, but unit value continued to rise. South Carolina vermiculite ore was mined by W. R. Grace & Co. and Patterson Vermiculite Co. in Laurens County. The ore was exfoliated at two plants by W. R. Grace & Co. and at one plant by Patterson Vermiculite Co. Vermiculite, a group of hydrated micaceous materials, has the property of expanding to 20 to 30 times its original volume when heated. The principal uses of the exfoliated material are for soil conditioning additives, for the manufacture of lightweight aggregates (concrete, plaster, and fireproofing), and in loose and block insulation.

METALS

No metal ores were mined in South Carolina in 1978 or 1979 for the recovery of their metallic content. Metallic ores formerly mined included gold, tin, lead, manganese, and copper. Although metals were not mined in the State, iron, steel, and ferroalloy production from ores obtained from out-of-State sources were significant in the State's economy in 1978 and 1979. The State ranked sixth nationally in the shipments of ferroalloys.

Ferroalloys.—Special ferroalloys were produced by Airco Alloys, a division of Airco, Inc., in Charleston, using ore imported from the U.S.S.R., Turkey, the Republic of South Africa, India, Iran, Albania, and several other countries. In July 1979, MACALLOY Corp. purchased the Charleston plant. MACALLOY is mainly involved in the manufacture of ferrochromium.

Iron and Steel.—Steel was produced in Georgetown by the Georgetown Steel Corp., a subsidiary of Korf Industries of the Federal Republic of Germany. Georgetown Steel was one of the Nation's major producers of wire rod. Pelletized ore and natural lump ore averaging 68% iron was imported from South America, South Africa, Sweden, and Australia. Sponge iron was produced from the ore by the MIDREX direct-reduction process by the company's companion firm, Georgetown Ferreduction. Georgetown Steel was one of two U.S. companies that was using this process, which allows a high-quality steel to be produced in electric-arc furnaces without coke ovens or blast furnaces.

Manganiferous Ore.—Manganiferous schist was mined by three companies in Cherokee County. The output was used by manufacturers in South Carolina and North Carolina for brick coloration.

Zircon.—Milled zircon (zirconium silicate) was produced by M & T Chemicals, Inc., in Georgetown County, using raw materials obtained from Florida, Georgia, and Australia. Zircon concentrates are processed by fine grinding and shipped for foundry, wall tile, whiteware, and general ceramic uses.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Giant Portland and Masonry Cement Co.	Box 218 Harleyville, SC 29448	Plant	Dorchester.
Gifford-Hill & Co., Inc	Box 326 Harleyville, SC 29448	do	Do.
Santee Portland Cement Corp	Box 698 Holly Hill, SC 29059	do	Orangeburg.
Clays:			
Common clay and shale:			
Giant Portland and Masonry Cement Co.	Box 218 Harleyville, SC 29448	Mine	Dorchester.
Gifford-Hill & Co., Inc	Box 326 Harleyville, SC 29448	do	Orangeburg.
Palmetto Brick Co	Box 430 Cheraw, SC 29520	do	Marlboro.
Richtex Corp	Box 3307 Columbia, SC 29230	do	Kershaw, Richland, Sumter.
Santee Portland Cement Corp	Box 698 Holly Hill, SC 29059	do	Orangeburg.
Southern Brick Co	Box 208 Ninety Six, SC 29666	do	Greenwood, Newberry, Saluda.
Fuller's earth:			
Bennett Mineral Co	Box 158 Pinewood, SC 29372	Mine and plant	Sumter.
Kaolin, processed:			
Dixie Clay Co	Box B Bath, SC 29816	do	Aiken.

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[1] State mineral specialist, Bureau of Mines, Tuscaloosa, Ala.

[2] State geologist, South Carolina Geological Survey, Columbia, S.C.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Clays —Continued			
Kaolin, processed —Continued			
J. M. Huber Corp	Box 306 Langley, SC 29834	Mine and plant	Aiken.
Palmetto Brick Co	Box 430 Cheraw, SC 29520	Mine	Kershaw.
Richtex Corp	Box 3307 Columbia, SC 29230	Mine and plant	Lexington and Richland.
Colemanite:			
Industrial Minerals, Inc	Box 459 York, SC 29745	Plant	York.
Feldspar, crude:			
Spartan Minerals Co., a division of Lithium Corp. of America.	Box 520 Pacolet, SC 29372	do	Spartanburg.
Manganiferous ore:			
Broad River Brick Co., a division of Boren Clay Products.	Box 550 Gaffney, SC 29340	Mine	Cherokee.
Mica (sericite):			
Mineral Mining Corp	Box 458 Kershaw, SC 29067	Mine and plant	Lancaster.
Peat:			
United States Peat Corp	Box 245 Green Pond, SC 29446	Bog and plant	Colleton.
Sand and gravel:			
Asphalt Producus Corp	Route 2 Lancaster, SC 29720	Pit and plant	Chesterfield, Darlington, Florence, Georgetown, Horry, Sumter.
Dickerson, Inc	Box 400 Monroe, SC 28110	do	Chester, Chesterfield, Lancaster, York.
Foster-Dixiana Sand Co	Box 5447 Columbia, SC 29250	do	Lexington.
Gifford-Hill & Co., Inc	Box 326 Harleyville, SC 29448	do	Orangeburg.
Lone Star Industries	Box 5185 Columbia, SC 29205	do	Richland.
Pennsylvania Glass Sand Corp	Box 84 Cayce, SC 29033	do	Lexington.
Stone:			
Granite, crushed and broken:			
Lone Star Industries	Box 5185 Columbia, SC 29205	Quarry and plant	Fairfield, Greenwood, Laurens, Richland.
Martin Marietta Aggregates	Box 1758 Columbia, SC 29202	do	Fairfield, Lexington, Richland, York.
Vulcan Materials Co	Box 188 Blacksburg, SC 29702	do	Greenville, Laurens, Pickens, Spartanburg.
Granite, dimension:			
Comolli Granite Co	R.F.D. 2, Box 297 Kershaw, SC 29067	Quarry	Kershaw.
Granite Quarry Corp	Penn Circle East Pittsburgh, PA 15206	do	Do.
Winnsboro Granite Corp	Rion, SC 29132	do	Fairfield.
Limestone, crushed:			
Martin Marietta Aggregates	Box 1758 Columbia, SC 29202	Quarry and plant	Berkeley and Georgetown.
Santee Portland Cement Co	Box 698 Holly Hill, SC 29059	Pit	Orangeburg.
Vulcan Materials Co	Box 188 Blacksburg, SC 29702	Quarry and plant	Cherokee.
Marl, crushed:			
Giant Portland and Masonry Cement Co.	Box 218 Harleyville, SC 29448	Pit	Dorchester.
Gifford-Hill & Co., Inc	Box 326 Harleyville, SC 29448	do	Do.
Vermiculite, crude and exfoliated:			
W. R. Grace & Co	Route 1 Enoree, SC 29335	Mine and plant	Greenville and Laurens.
Patterson Vermiculite Co	do	do	Laurens.

The Mineral Industry of South Dakota

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the South Dakota Geological Survey for collecting information on all nonfuel minerals.

By James H. Aase,[1] Wanda J. West,[2] and Fred V. Steece[3]

The value of nonfuel mineral production in South Dakota for 1978 and 1979 was $114.8 million and $148.7 million, respectively, setting records each year.

The State's nonfuel mineral output was derived from three metallic and nine nonmetallic mineral commodities. Gold continued as the leading commodity in terms of value during the biennium 1978-79, accounting for approximately half of the State total. Other principal mineral commodities produced, in descending order of value, included cement, stone, and sand and gravel.

Nationally, South Dakota ranked 38th among the States in value of nonfuel mineral production in 1978. The State led the Nation in gold production in 1978 and was second, following Utah, in 1979.

Although the quantity of gold produced in

Table 1.—Nonfuel mineral production in South Dakota[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:						
Masonry thousand short tons	W	W	W	W	7	$434
Portland do	W	W	W	W	670	31,273
Clays do	[2]197	[2]$233	[2]216	[2]$268	205	292
Gem stones	NA	40	NA	50	NA	50
Gold (recoverable content of ores, etc.) troy ounces	304,846	45,212	285,512	55,261	245,912	75,618
Mica, scrap thousand short tons	(3)	5	(3)	4	(3)	2
Sand and gravel do	6,043	9,815	6,404	11,100	6,001	10,119
Silver (recoverable content of ores, etc.) thousand troy ounces	69	317	53	287	58	643
Stone:						
Crushed thousand short tons	3,377	7,477	3,693	8,376	3,891	10,317
Dimension do	35	11,404	36	11,859	36	13,268
Combined value of beryllium concentrate (1977), clays (bentonite, 1977-78), feldspar, gypsum, iron ore (1978-79), lime, and values indicated by symbol W	XX	28,282	XX	27,554	XX	6,670
Total	XX	102,785	XX	114,759	XX	148,686

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Combined value" figure.
XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes bentonite; value included in "Combined value" figure.

[3] Less than 1/2 unit.

Table 2.—Value of nonfuel mineral production in South Dakota, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Aurora	$35	--	
Beadle	23	$17	Sand and gravel.
Bon Homme	50	--	
Brookings	825	946	Sand and gravel.
Brown	221	508	Do.
Butte	W	W	Clays, sand and gravel.
Campbell	100	W	Sand and gravel.
Charles Mix	236	224	Do.
Clark	83	99	Do.
Clay	24	21	Do.
Codington	W	W	Do.
Corson	55	W	Do.
Custer	W	W	Stone, feldspar.
Davison	62	59	Sand and gravel.
Day	113	221	Do.
Deuel	83	119	Do.
Dewey	54	54	Do.
Douglas	W	W	Do.
Fall River	W	W	Sand and gravel, stone.
Faulk	100	76	Sand and gravel.
Grant	W	W	Stone, sand and gravel.
Gregory	216	65	Sand and gravel.
Haakon	18	18	Do.
Hamlin	52	W	Do.
Hand	W	W	Do.
Hanson	W	W	Stone, sand and gravel.
Harding	--	18	Sand and gravel.
Hughes	--	93	Do.
Hutchinson	99	101	Do.
Hyde	114	113	Do.
Jerauld	109	74	Do.
Jones	59	50	Do.
Kingsbury	22	22	Do.
Lake	W	W	Do.
Lawrence	W	56,264	Gold, sand and gravel, silver, iron ore, stone.
Lincoln	105	32	Sand and gravel.
Lyman	42	78	Do.
McCook	W	W	Do.
McPherson	134	W	Do.
Marshall	W	W	Do.
Meade	W	W	Sand and gravel, gypsum.
Miner	35	37	Sand and gravel.
Minnehaha	W	W	Stone, sand and gravel.
Moody	178	160	Sand and gravel.
Pennington	30,518	W	Cement, stone, lime, sand and gravel, clays, mica.
Perkins	W	462	Sand and gravel.
Potter	60	W	Do.
Roberts	W	W	Do.
Sanborn	--	W	Do.
Spink	149	217	Do.
Sully	42	68	Do.
Tripp	42	35	Stone.
Turner	--	W	Sand and gravel.
Union	64	112	Do.
Walworth	W	132	Do.
Washabaugh	--	164	Do.
Yankton	W	W	Sand and gravel, stone.
Ziebach	W	W	Sand and gravel.
Undistributed[2]	68,666	54,107	
Total[3]	102,785	114,759	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] The following counties are not listed because no nonfuel mineral production was reported: Bennett, Brule, Buffalo, Edmunds, Jackson, Mellette, Shannon, Stanley, and Todd.

[2] Includes gem stones, sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

the State decreased in each year of the biennium from that of the previous year, the total value of produced gold increased. Major advances in the price of gold during the biennium raised the average value to approximately $194 per troy ounce in 1978 and $308 per troy ounce in 1979, and were the principal factors contributing to the State's record high value of nonfuel mineral production set each year.

Nonfuel mineral production during the biennium was from approximately 150 firms and various governmental agencies operating out of 170 sites in 57 of the State's 67 counties. Lawrence County, followed by Pennington County, continued as the State's leading counties in terms of value of nonfuel mineral output. Production valued in excess of $1 million each year of the biennium was recorded in four counties.

One of the State's oldest mineral-processing facilities, the brick plant of Black Hills Clay Products Co. in Butte County, terminated its operation near yearend 1978. The plant, with a reported capacity of 7.2 million bricks per year, went into operation in 1927, and has been the sole producer of clay brick in the State during the past two decades. Salvageable equipment will be utilized by an affiliate company plant in North Dakota, where better fuel efficiency in processing reportedly can be attained.

In June 1979, a new 3-year contract was signed between management of the Homestake gold mine at Lead and its miners' union, 1,350 workers of United Steelworkers of America, Local 7044. Under terms of the contract, workers will receive an 8% annual wage increase in each of the contract's 3 years; a 7-cent-per-hour increase in wages for every $5-increase in the price of gold above the $275-per-ounce level, up to a maximum of 80 cents per hour; and a reduction in the workday from 8 1/2 hours to 8 hours, plus a one-time bonus of $1,000 for miners, and between $250 and $300 for surface workers, to compensate them for the reduction in the workweek.

South Dakota and much of the Nation experienced a serious cement shortage in 1978. At midyear 1978, a policy decision was made by the South Dakota Cement Commission to halt sales of cement from the State-owned plant in Rapid City to out-of-State customers. Continued mechanical problems encountered during shakedown operations of a new kiln installed to double plant capacity, together with increased in-State demand, intensified the situation. This policy raised protests from customers in neighboring States, and the matter was taken to court. After a series of lower court rulings, the Eighth U.S. Circuit Court of Appeals

Table 3.—Indicators of South Dakota business activity

	1977	1978	1979^p	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	317.0	328.0	338.0	+3.0
Unemployment do	10.0	10.0	12.0	+20.0
Employment (nonagricultural):				
Mining[1] do	2.6	2.8	2.8	--
Manufacturing do	23.4	24.9	26.9	+8.0
Contract construction do	12.4	13.6	12.3	-9.6
Transportation and public utilities do	12.6	13.4	13.7	+2.2
Wholesale and retail trade do	62.3	65.2	66.6	+2.1
Finance, insurance, real estate do	10.1	10.6	11.0	+3.8
Services do	46.6	48.0	48.8	+1.7
Government do	56.6	58.1	58.1	--
Total nonagricultural employment[1] do	226.6	236.6	240.2	+1.5
Personal income:				
Total millions	$4,028	$4,541	$5,053	+11.3
Per capita	$5,859	$6,585	$7,334	+11.4
Construction activity:				
Number of private and public residential units authorized	5,983	[2]5,287	4,288	-18.9
Value of nonresidential construction millions	$77.1	$57.1	$99.7	+74.6
Value of State road contract awards do	$45.0	$39.0	$78.0	+100.0
Shipments of portland and masonry cement to and within the State thousand short tons	380	354	419	+18.4
Nonfuel mineral production value:				
Total crude mineral value millions	$102.8	$114.8	$148.7	+29.5
Value per capita, resident population	$149	$166	$216	+30.1
Value per square mile	$1,334	$1,489	$1,930	+29.6

[p] Preliminary.
[1] Includes oil and gas extraction.
[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

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ruled in favor of the South Dakota Cement Commission policy. In May 1979, the U.S. Supreme Court, after an appeal from an out-of-State customer, sent the case back to the Eighth Circuit Court for further consideration. The Eighth Circuit Court stood by its earlier ruling. Near yearend 1979, a second petition was made to the U.S. Supreme Court to override the most recent decision and to have it hear the case. Until the Supreme Court decides either to hear the case or to deny the appeal, the Eighth Circuit Court of Appeals ruling will stand, which allows South Dakota the right to favor its own residents over others in the sale of its State-produced cement.

In 1979, by Executive Order of the Governor, the State's Department of Natural Resource Development and the Department of Environmental Protection were combined into a new Department of Water and Natural Resources.

On July 1, 1978, the deadline date was reached for holders of severed mineral rights on lands in the State to file with the appropriate county registrar a description of their interest, under provision of a law enacted in 1976. Failure to file by the deadline allows the surface owner to file claim to sole possession of property and rights described and to obtain ownership of the mineral estate involved.

The South Dakota Geological Survey continued basic research projects involving mineral and water resources of the State during the biennium. County ground water and mineral resource studies were conducted in cooperation with the U.S. Geological Survey, the County Commissioners, and the Conservancy Subdistricts. Typically, a county study presented the details of sand and gravel deposits of an area, including the thickness, distribution, and character of the deposits.

The State Geological Survey participated in a project during 1978-79 to evaluate the uranium resources of the Lemmon and Hot Springs 2° quadrangle sheets.

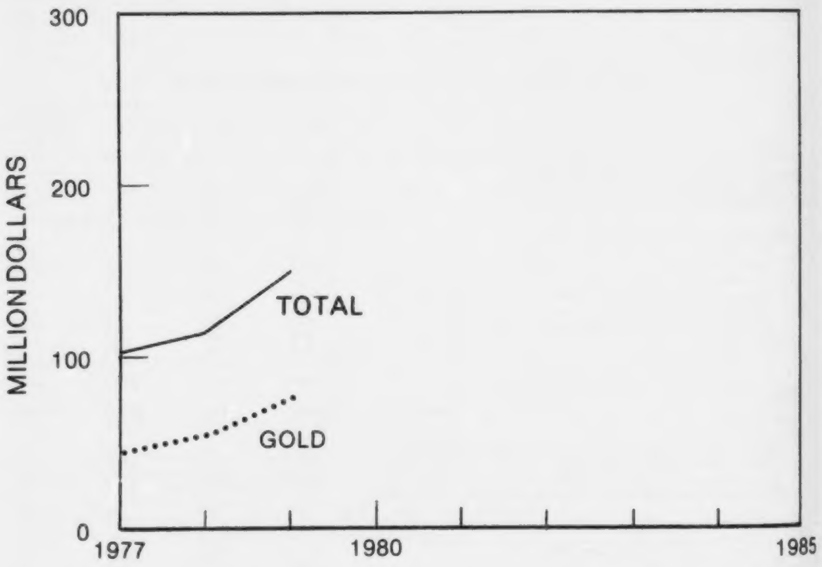

Figure 1.—Value of mine production of gold and total value of nonfuel mineral production in South Dakota.

The Public Library, Newark, N.J.

Legislation and Government Programs.—During the 1978 and 1979 sessions of the South Dakota Legislature, a number of bills of interest to the mineral industry were enacted into law. Among the laws passed during the 1978 legislative session were measures which set additional standards for surface mining and exploration (included seismic holes in the definition of exploration drilling and required a performance bond on all holes for exploration purposes) and detailed plugging methods for borings and information filing requirements; transferred the administration and enforcement responsibility for mineral exploration, except oil and gas, from the Department of Natural Resource Development to the Department of Agriculture, Division of Conservation; and established new rules for mineral exploration on State lands, including lands in which the State has a mineral interest.

Laws enacted during the 1979 legislative session included measures which required additional surface restoration bonds to insure agreements between operators and landowners or lessees regarding surface damage resulting from drilling operations; broadened severance tax liability to include operators, and defined operators; and prohibited foreign ownership of agricultural land in the State in excess of 160 acres, but did not include any royalty interest or other mineral interest or any lease, option, or easement relating thereto.

On December 4, 1979, the South Dakota School of Mines and Technology was designated by the Secretary of the Interior as a State Mining and Mineral Resources Research Institute pursuant to Title III of Public Law 95-87.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Gold.—Gold prices continued to advance during the biennium, rising an average of $45 per troy ounce in 1978 and another $115 per troy ounce in 1979. South Dakota accounted for slightly more than one-quarter of the Nation's gold output during 1978-79, with production coming solely from the Homestake Mining Co.'s lode mine at Lead. Recovery of gold from the lode mine ore produced in the State decreased to 0.17 ounce per ton in 1979 from 0.18 ounce per ton in 1978.

Near yearend 1979, Homestake Mining Co. rebuilt various components of its gold mine at Lead. A new main drum shaft weighing 40 tons and measuring 40 feet in length by 30 inches in diameter was installed on the hoist at the Ross shaft, and the clutch spider, clutch ring, and brake ring were rebuilt. At the No. 6 hoist, six new lift ropes and three new tail ropes were installed, together with new liners on the hoist drum and crosshead.

Table 4.—South Dakota: Lode mine production (recoverable) of gold and silver

	1977	1978	1979
Mines producing: Lode	1	1	1
Material sold or treated: Gold ore ____ thousand metric tons	1,432	1,442	1,297
Production:			
Quantity:			
Gold ____ troy ounces	304,766	285,512	245,912
Silver ____ do	68,717	53,099	57,973
Value:			
Gold ____ thousands	$45,200	$55,261	$75,618
Silver ____ do	$317	$287	$643
Total ____ do	$45,517	$55,548	$76,261

Table 5.—South Dakota: Homestake mine ore milled and receipts for gold produced

Year	Ore milled (thousand metric tons)	Receipts for gold produced	
		Total (thousands)	Per ton
1975	1,336	$49,244	$36.86
1976	1,504	39,916	26.54
1977	1,432	45,200	31.56
1978	1,442	55,261	38.32
1979	1,297	75,618	58.30

Iron Ore.—Pete Lien & Sons, Inc., operated a small open pit mine near Nemo in Lawrence County during 1978 and 1979. The entire output was shipped to the State-owned cement plant in Rapid City for use in the manufacture of cement.

Silver.—Production of silver in 1979 increased slightly in quantity and significantly in value over that of the previous year. The average value of the silver produced during 1979 was $11.09 per troy ounce, compared with $5.40 per troy ounce in 1978. The silver was obtained as a coproduct with the gold produced at the Homestake mine in Lead.

NONMETALS

Cement.—Cement manufactured in 1978 and 1979 came from the State-owned plant at Rapid City, in Pennington County. Three types of portland cement and a prepared masonry cement were manufactured at the facility. The plant, with a rated production capacity of 3,300 tons per 24 hours, used three wet-process kilns of 375-foot length and one dry-process kiln of 220-foot length in its production line. Ready-mix companies were the largest users of the portland cement produced, consuming more than half of the output in recent years. Over three-fourths of the cement shipped from the plant was handled by truck in bulk form. Approximately 1 3/4 tons of mineral raw material mined in the State were used in each ton of cement produced.

Clays.—American Colloid Co. continued to operate the State's only bentonite processing plant, near Belle Fourche in Butte County, during the biennium. In 1978, the plant used crude material obtained from deposits within the State and Wyoming. During 1979, all crude material processed was obtained from out-of-State sources. The bentonite was used principally in oil and gas drilling muds, foundry sands, animal feeds, and waterproofing sealants. Bentonite accounted for the largest part of the total value of clay produced in South Dakota during 1978.

Black Hills Clay Products Co. produced common clay for use at its brickmaking facility in Belle Fourche until near yearend 1978, when it permanently terminated the operation. The plant, established in 1927, was the only producer of clay brick in the State.

The South Dakota Cement Commission and Dakota Block Co. obtained common clay and shale from pits in Pennington County for use in cement and lightweight aggregate manufacturing, respectively.

Feldspar.—In 1978 and 1979, feldspar was produced at several small mines located in the southern Black Hills area of Custer County. The bulk of the hand-cobbed feldspar recovered was processed through a grinding mill operated by Pacer Corp. in Custer.

Gem Stones.—Gem stones were recovered only by mineral collectors and other hobbyists.

Gypsum.—The South Dakota Cement Commission operated an open pit gypsum mine in Meade County. The entire output was used by the Commission in the manufacture of portland and masonry cement at its Rapid City plant.

Lime.—The State's entire production of lime during 1978-79 was from the Pete Lien & Sons, Inc., plant in Rapid City, Pennington County. In 1979, a plant improvement program was initiated by the company to reduce fuel consumption and to increase production capacity. A three-bay preheater and a 14-inch-diameter contact cooler were installed on the kiln, and a conversion was made in processing fuel from gas to coal.

Consumption of quicklime and hydrated lime in South Dakota, obtained from both in- and out-of-State sources, was 30,000 tons in 1979 compared with 22,000 tons the previous year.

Mica.—In 1978 and 1979, the Pendleton Mining Co. produced hand-cobbed mica from a pegmatite deposit near Keystone in Pennington County.

Sand and Gravel.—Sand and gravel production in recent years has accounted for slightly less than 10% of the value of all nonfuel minerals produced in the State.

During the biennium, South Dakota's sand and gravel industry operated pits scattered throughout the State that ranged widely in their individual production. In 1978, 118 firms and government agencies produced sand and gravel from 131 deposits located in 54 counties. Production from the individual deposits ranged from less than 25,000 tons to 400,000 tons, with 46% reporting output of less than 25,000 tons; 38% between 25,000 and 100,000 tons; 11% between 100,000 and 200,000 tons; and the remainder between 200,000 and 400,000 tons.

Table 6.—South Dakota: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,219	$2,611	$2.14	1,466	$3,357	$2.29	1,329	$3,305	$2.49
Plaster and gunite sands	NA	NA	NA	4	13	3.38	W	W	3.24
Concrete products	208	476	2.29	63	126	1.99	W	W	2.01
Asphaltic concrete	909	1,521	1.67	919	1,534	1.67	605	934	1.55
Roadbase and coverings	2,046	3,379	1.65	3,219	5,200	1.62	3,110	4,660	1.50
Fill	1,593	1,747	1.10	681	704	1.17	853	1,030	1.21
Snow and ice control	NA	NA	NA	50	63	1.26	42	55	1.29
Railroad ballast	1	4	3.00	--	--	--	--	--	--
Other uses	67	78	1.16	3	16	4.92	7	16	2.32
Total[1] or average	6,043	9,815	1.62	6,404	11,100	1.73	6,001	10,119	1.69

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Table 7.—South Dakota: Construction sand and gravel sold or used by producers

	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	1,358	$2,352	$1.73	1,838	$3,336	$1.81	1,441	$2,750	$1.91
Gravel	4,685	7,463	1.59	4,566	7,767	1.70	4,560	7,369	1.62
Total or average	6,043	9,815	1.62	6,404	[1]11,100	1.73	6,001	10,119	1.69

[1] Data do not add to total shown because of independent rounding.

Table 8.—South Dakota: Construction sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1977			1978			1979		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Aurora	1	35	35	--	--	--	--	--	--
Beadle	1	15	23	1	10	17	1	32	43
Bon Homme	1	50	50	--	--	--	--	--	--
Brookings	5	503	825	6	591	946	5	433	718
Brown	4	132	221	7	263	508	8	278	461
Campbell	3	43	100	2	W	W	2	W	W
Charles Mix	6	166	236	5	149	224	4	146	216
Clark	1	53	83	1	60	99	1	W	W

See footnotes at end of table.

Table 8.—South Dakota: Construction sand and gravel sold or used by producers, by county —Continued

(Thousand short tons and thousand dollars)

County	1977			1978			1979		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Clay	1	21	24	1	13	21	1	35	44
Codington	2	W	W	2	W	W	3	201	498
Corson	1	55	55	1	W	W	1	7	11
Custer	1	14	14	--	--	--	1	17	17
Davison	3	35	62	3	42	59	4	88	101
Day	3	35	113	4	140	221	4	108	121
Deuel	2	W	83	2	76	119	2	W	W
Dewey	1	36	54	1	36	54	1	36	54
Fall River	3	270	473	3	236	476	3	200	527
Faulk	1	100	100	1	46	76	1	50	75
Gregory	3	139	216	3	39	65	3	32	51
Haakon	1	12	18	1	12	18	1	12	18
Hamlin	1	52	52	2	W	W	2	W	W
Hanson	1	22	22	1	W	W	1	W	W
Harding	--	--	--	2	10	18	--	--	--
Hughes	--	--	--	2	38	93	2	28	W
Hutchinson	5	68	99	5	44	101	5	86	92
Hyde	1	60	114	1	75	113	1	60	150
Jerauld	3	70	109	2	44	74	2	43	54
Jones	1	30	59	1	W	50	1	35	35
Kingsbury	4	17	22	4	17	22	4	17	22
Lincoln	3	61	105	2	20	32	--	--	--
Lyman	1	33	42	1	W	78	1	29	44
McPherson	1	100	134	2	W	W	2	W	W
Miner	1	35	35	1	23	37	1	17	19
Minnehaha	10	749	1,137	11	1,028	1,460	11	993	1,399
Moody	4	140	178	3	118	160	3	123	159
Pennington	6	321	556	6	365	821	7	302	800
Perkins	2	W	W	3	183	462	3	79	230
Potter	1	60	60	1	W	W	1	70	113
Spink	3	125	149	2	192	217	2	W	133
Sully	1	26	42	1	53	68	1	32	34
Union	4	54	64	4	83	112	4	112	156
Walworth	2	61	W	2	78	132	2	106	106
Washabaugh	--	--	--	1	W	164	([1])	([1])	([1])
Yankton	4	313	562	4	169	284	5	246	429
Ziebach	1	132	W	1	W	W	1	W	W
Undistributed[2]	20	1,741	3,492	22	2,149	3,705	24	1,948	3,194
Total[3]	124	6,043	9,815	131	6,404	11,100	132	6,001	10,119

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Washabaugh County merged with Jackson County on January 1, 1979, and will be known hereafter as Jackson County.

[2] Includes Brule (1979), Butte, Douglas, Grant, Hand, Lake, Lawrence, McCook, Marshall, Meade, Roberts, Sanborn (1978-79), and Turner (1978-79) Counties, sand and gravel that cannot be assigned to specific counties, and data indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Stone.—Granite, limestone, and sandstone were produced in the State during 1978-79. Stone ranked first in terms of value of all nonmetallic minerals produced in South Dakota, accounting for nearly one-fifth of the total State value during the biennium.

Stone output was greater in quantity and value in both years than in the previous respective years. In 1979, production was recorded from 19 quarries, operated by 14 firms located in 8 counties. Pennington County was the leader in crushed stone production; all dimension stone output was from Grant County.

Output of limestone exceeded that of any other type of rock. Limestone from seven deposits in Custer, Fall River, Lawrence, and Pennington Counties was crushed and used most extensively as a concrete aggregate.

Granite was quarried by six companies at eight quarries near Milbank in Grant County. Most of the dimension granite was used in making monuments. Crushed granite was utilized as aggregate.

Sandstone was produced by four companies at four sites in Hanson, Minnehaha, and Tripp Counties. Principal usage was as an aggregate for concrete, with lesser amounts used as bituminous aggregate, railroad ballast, and riprap.

More than half of the State's total stone output in 1979 was from the operations of two firms. Production from individual quarry operations throughout the State ranged from less than 25,000 tons to more than 900,000 tons per year. In 1979, nine quarries produced less than 25,000 tons; one quarry between 75,000 and 100,000 tons; seven quarries between 100,000 and 500,000 tons; and two quarries more than 900,000 tons. Sixty-two percent of the crushed stone was shipped by truck, and virtually all of the remainder was handled by rail.

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[1] State mineral specialist, Bureau of Mines, Twin Cities, Minn.

[2] Program assistant, Bureau of Mines, Twin Cities, Minn.

[3] Assistant state geologist, South Dakota Geological Survey, Rapid City, S. Dak.

Table 9.—South Dakota: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate	1,403	3,487	1,514	4,168	1,576	5,612
Bituminous aggregate	314	818	237	606	251	658
Macadam aggregate	2	3	--	--	--	--
Dense-graded roadbase stone	188	366	W	W	W	W
Surface treatment aggregate	53	121	75	143	80	169
Other construction aggregate and roadstone	113	140	182	331	131	160
Riprap and jetty stone	38	97	112	445	113	452
Railroad ballast	333	868	284	675	284	674
Cement manufacture	612	971	756	1,005	W	W
Lime manufacture	265	475	302	528	310	589
Other uses[2]	56	132	231	475	1,145	2,002
Total[3]	3,377	7,477	3,693	8,376	3,891	10,317

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes granite, limestone, and sandstone.

[2] Includes stone used for agricultural limestone (1977-78), unspecified uses, and data indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 10.—South Dakota: Stone sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Kind of stone	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Dimension stone, total[1]	35	11,404	36	11,859	36	13,268
Crushed and broken:						
Granite	77	77	77	77	77	77
Limestone	2,276	4,249	2,584	4,702	2,789	6,640
Sandstone	1,024	3,151	1,031	3,598	1,025	3,600
Total[2]	3,412	18,881	3,729	20,236	3,926	23,585

[1] Data represent granite.

[2] Data may not add to totals shown because of independent rounding.

Table 11.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
South Dakota Cement Commission.	Box 360 Rapid City, SD 57709	Four rotary kilns	Pennington.
Clays:			
American Colloid Co	Box 160 Belle Fourche, SD 57717	Open pit mine and plant	Butte.
Black Hills Clay Products Co	1516 Mill St. Belle Fourche, SD 57717	Open pit mine and brick plant.	Do.
Dakota Block Co.	Box 2920 Rapid City, SD 57709	Open pit mine and plant	Pennington.
South Dakota Cement Commission.	Box 360 Rapid City, SD 57709	Open pit mine	Do.
Feldspar:			
Pacer Corp	Box 311 Custer, SD 57730	Open pit mines and dry-grinding plant.	Custer.
Gold:			
Homestake Mining Co	Lead, SD 57754	Underground mine, cyanidation mill, and refinery.	Lawrence.

Table 11.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Gypsum:			
South Dakota Cement Commission.	Box 360 Rapid City, SD 57709	Open pit mine	Meade.
Iron ore:			
Pete Lien & Sons, Inc	Box 440 Rapid City, SD 57709	do	Lawrence.
Lime:			
Pete Lien & Sons, Inc	do	1 rotary kiln, 1 vertical kiln, continuous-hydrator plant.	Pennington.
Mica:			
Pendleton Mining Co	Box 286 Keystone, SD 57751	Mine	Do.
Sand and gravel:			
W. E. Bartholow & Sons Construction Co.	Box 3 Huron, SD 57350	Pits and plants	Various.
Birdsall Sand & Gravel Co., Inc	Box 767 Rapid City, SD 57709	do	Fall River and Pennington.
Harold Borgen	Renner, SD 57055	Pit and plant	Minnehaha.
Concrete Materials Co	100 South Dakota Ave. Sioux Falls, SD 57102	Pits and plant	Minnehaha and Roberts.
L. G. Everist, Inc	302 Paulton Bldg. Sioux Falls, SD 57102	Pits and plants	Brookings and Yankton.
Fodness Gravel	Route 5 Sioux Falls, SD 57101	Pit and plant	Minnehaha.
Hallett Construction Co	Box 90 St. Peter, MN 56082	do	Codington.
Vyrl H. Norman	Route 1 Belle Fourche, SD 57717	Pit	Butte.
Reynolds Construction Co	Box 689 Sioux Falls, SD 57101	Pit and plant	Minnehaha.
Silver:			
Homestake Mining Co	Lead, SD 57754	*See* Gold	Lawrence.
Stone:			
Granite:			
Cold Spring Granite Co	Cold Spring, MN 56320	2 quarries	Grant.
Dakota Granite Co	Box 1351 Milbank, SD 57252	do	Do.
Delano Granite Works, Inc	Delano, MN 55328	Quarry	Do.
Robert Hunter Granite Co., Inc.	501 East Drake St. Milbank, SD 57252	do	Do.
Sequoya Granite Co	Box 1083 Milbank, SD 57252	do	Do.
Steiner-Rausch Granite Co	Route 2, Box 36 Ortonville, MN 56278	do	Do.
Limestone:			
Pete Lien & Sons, Inc	Box 440 Rapid City, SD 57709	2 quarries and plants	Custer and Pennington.
Northwestern Engineering Co.	Box 1392 Rapid City, SD 57709	do	Fall River and Pennington.
South Dakota Cement Commission.	Box 360 Rapid City, SD 57709	Quarry and plant	Pennington.
Sandstone:			
Concrete Materials Co	100 South Dakota Ave. Sioux Falls, SD 57102	do	Minnehaha.
L. G. Everist, Inc	302 Paulton Bldg. Sioux Falls, SD 57102	do	Do.
Spencer Quarries, Inc	Spencer, SD 57374	Quarry	Hanson.

The Mineral Industry of Tennessee

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Tennessee Division of Geology, for collecting information on all nonfuel minerals.

By Donald K. Harrison[1] and Stuart W. Maher[2]

The value of Tennessee's nonfuel mineral production in 1978 and 1979 was $346.8 million and $385.7 million, respectively. In 1979, the State was the Nation's leading producer of zinc, ball clay, and pyrite; third in ferroalloys; and fourth in phosphate rock. In terms of value, stone continued to be the leading commodity produced. Primary metals, chemicals, and glass products were important mineral-related industries in the State.

Trends and Developments.—During 1978 and 1979, the mineral industry was active in exploration for, and development of, zinc and fluorspar deposits in the State.

Jersey Miniere Zinc Co. continued developing the Gordonsville zinc mine and began operating a new electrolytic zinc refinery at Clarksville in late 1978. The new $210 million refinery, with a rated capacity of 90,000 short tons per year of slab zinc, received concentrates from the company's Elmwood mine in 1978 and 1979. The refinery is expected to be supplemented by the Gordonsville mine when development work is completed. A new 9,000-short-ton-per-day concentrator was also completed at Gordonsville.

In 1978, Carthage Zinc Co., a joint venture between St. Joe Minerals Corp. and Freeport Minerals Co., began underground exploration at the Carthage zinc project near the city of Carthage. Exploration continued into 1979.

New Jersey Zinc continued development of the Beaver Creek and Lost Creek zinc mines in the Mascot-Jefferson City district.

In late 1977, ASARCO Incorporated closed the Coy and New Market mines in the Jefferson City-Mascot district because of ample inventories and the depressed zinc market. Both mines were reopened in 1979, but strikes during the year disrupted production.

In 1979, Exxon Minerals Co., U.S.A., continued exploration work at the Sugar Creek zinc prospect near Gainesboro. Final results of its work were not announced.

Cities Service Co. closed down its iron pellet facility at Copperhill in early 1979, although the company continued mining and milling copper and continued its chemical operations.

In 1978, U.S. Borax began an assessment of its large barite-fluorite-zinc deposit in the Sweetwater district, in eastern Tennessee. The company was still evaluating the project in 1979.

Legislation and Government Programs.—In 1977, the Forest Service of the U.S. Department of Agriculture initiated its Roadless Area Review and Evaluation (RARE II) program. The program identified roadless and undeveloped land areas in the National Forest System suitable for wilderness use. In 1978, three areas in the Cherokee National Forest, in eastern Tennessee, were evaluated. Bald River Gorge (3,887 acres) was nominated for wilderness status. An additional 38,100 acres were designated for further planning, and approximately 91,000 acres were recommended for nonwilderness classification. A mineral resource appraisal of Bald River Gorge, conducted jointly by the Federal Bureau of Mines and U.S. Geological Survey, is expected to be undertaken in the near future.

The Tennessee Division of Geology, in cooperation with the Federal Bureau of Mines, continued evaluating the State's limestone-dolomite and clay resources. In 1978, 64 limestone-dolomite samples were analyzed by the Bureau of Mines Reno Research Center, Reno, Nev. Clay and shale samples were tested at the Bureau of Mines Tuscaloosa Research Center, Tuscaloosa, Ala.

The State Department of Conservation, Division of Surface Mining, issued 58 nonfuel mining permits on 3,294 acres. Principal commodities for which permits were obtained included sand and gravel, clay, phosphate, and barite.

Table 1.—Nonfuel mineral production in Tennessee[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:						
Masonry thousand short tons	195	$7,878	217	$10,443	170	$8,600
Portland do.	1,522	52,894	1,568	60,223	1,335	57,146
Clays do.	[2]1,578	[2]13,968	1,760	21,719	1,561	26,071
Copper (recoverable content of ores, etc.) metric tons	5,613	8,266	11,289	16,550	W	W
Gem stones	--	--	NA	1	NA	1
Gold (recoverable content of ores, etc.) troy ounces	13	2	W	W	--	--
Phosphate rock thousand metric tons	1,747	14,253	1,709	14,047	1,873	14,770
Sand and gravel thousand short tons	12,773	29,197	11,960	28,630	11,210	29,056
Silver (recoverable content of ores, etc.) thousand troy ounces	60	278	W	W	W	W
Stone:						
Crushed thousand short tons	41,897	99,196	45,460	117,271	45,718	133,727
Dimension do.	13	941	12	1,035	12	1,000
Zinc (recoverable content of ores, etc.) metric tons	82,044	62,221	87,906	60,078	85,119	69,996
Combined value of barite, clays (bentonite and fuller's earth, 1977), lime, pyrites, and values indicated by symbol W	XX	14,585	XX	16,845	XX	45,878
Total	XX	303,679	XX	346,842	XX	385,744

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes bentonite and fuller's earth; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Tennessee, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Anderson	W	W	Stone, sand and gravel.
Bedford	$1,108	W	Stone.
Benton	W	W	Sand and gravel, stone.
Blount	W	$3,881	Stone.
Bradley	W	W	Do.
Campbell	W	3,221	Stone, sand and gravel.
Cannon	161	W	Stone.
Carroll	1,430	1,497	Clays.
Carter	W	W	Stone.
Claiborne	W	W	Do.
Clay	138	138	Do.
Cocke	170	149	Do.
Coffee	W	W	Sand and gravel, stone.
Cumberland	W	4,834	Stone, sand and gravel.
Davidson	W	W	Stone, cement, clays.
Decatur	W	W	Stone, sand and gravel.
DeKalb	409	W	Stone.
Dickson	W	W	Do.
Dyer	W	640	Sand and gravel.
Fayette	99	118	Do.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Tennessee, by county[1] —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Fentress	W	W	Stone, sand and gravel.
Franklin	W	W	Cement, stone, sand and gravel, clays.
Gibson	W	428	Clays.
Giles	W	W	Phosphate rock, stone, sand and gravel.
Grainger	W	W	Zinc, stone.
Greene	W	W	Stone, sand and gravel.
Grundy	W	W	Stone.
Hamblen	W	W	Do.
Hamilton	23,281	26,661	Cement, stone, sand and gravel, clays.
Hardeman	W	W	Sand and gravel.
Hardin	W	W	Stone, sand and gravel.
Hawkins	W	W	Stone.
Henry	W	7,732	Clays, sand and gravel.
Hickman	W	W	Phosphate rock.
Humphreys	W	W	Stone, sand and gravel.
Jackson	W	W	Stone.
Jefferson	41,197	36,262	Zinc, stone, silver.
Johnson	W	W	Stone.
Knox	32,343	39,716	Cement, zinc, stone, lime, clays, sand and gravel.
Lauderdale	125	92	Sand and gravel.
Lawrence	609	804	Stone, sand and gravel.
Lincoln	W	W	Stone.
Loudon	W	W	Barite, stone.
McMinn	W	W	Lime, stone, sand and gravel.
McNairy	W	345	Sand and gravel.
Macon	--	W	Stone.
Madison	158	180	Sand and gravel.
Marion	W	W	Cement, stone, sand and gravel.
Marshall	W	W	Stone.
Maury	W	W	Phosphate rock, stone.
Meigs	W	W	Stone.
Monroe	W	W	Do.
Montgomery	W	W	Do.
Moore	W	W	Do.
Obion	640	799	Sand and gravel.
Overton	468	W	Stone.
Perry	406	--	
Pickett	62	--	
Polk	16,653	W	Copper, pyrites, zinc, silver, gold.
Putnam	W	W	Stone, sand and gravel.
Rhea	W	W	Stone.
Roane	W	W	Stone, sand and gravel.
Robertson	W	W	Stone.
Rutherford	2,229	2,925	Do.
Sequatchie	W	W	Do.
Sevier	W	W	Stone, sand and gravel.
Shelby	10,366	7,763	Sand and gravel.
Smith	W	W	Zinc, stone.
Stewart	W	W	Sand and gravel, stone.
Sullivan	W	W	Cement, stone, clays.
Sumner	W	W	Stone.
Tipton	919	1,269	Sand and gravel.
Unicoi	W	W	Stone, sand and gravel.
Union	2,200	3,526	Do.
Van Buren	W	--	
Warren	W	1,062	Stone.
Washington	W	W	Sand and gravel, clays, stone.
Wayne	136	W	Sand and gravel.
Weakley	7,919	W	Clays.
White	W	W	Stone.
Williamson	W	W	Phosphate rock, stone.
Wilson	W	W	Stone.
Undistributed[2]	160,456	202,820	
Total[3]	303,679	346,842	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] The following counties are not listed because no nonfuel mineral production was reported: Bledsoe, Cheatham, Chester, Crockett, Hancock, Haywood, Henderson, Houston, Lake, Lewis, Morgan, Scott, and Trousdale.

[2] Includes sand and gravel and gem stones that cannot be assigned to specific counties and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

The Public Library, Newark, N.J.

Table 3.—Indicators of Tennessee business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	1,903.0	1,916.0	1,979.0	+3.3
Unemployment do	120.0	110.0	115.0	+4.5
Employment (nonagricultural):				
Mining[1] do	9.9	10.8	10.7	-.9
Manufacturing do	507.5	526.0	529.4	+.6
Contract construction do	78.4	87.3	90.4	+3.6
Transportation and public utilities do	78.3	83.2	87.2	+4.8
Wholesale and retail trade do	357.2	379.1	388.8	+2.6
Finance, insurance, real estate do	71.1	74.3	77.4	+4.2
Services do	254.5	270.7	286.8	+5.9
Government do	291.2	305.6	314.4	+2.9
Total nonagricultural employment[3] do	1,648.1	1,737.0	1,785.1	+2.8
Personal income:				
Total millions	$25,173	$28,592	$31,972	+11.8
Per capita	$5,865	$6,561	$7,299	+11.2
Construction activity:				
Number of private and public residential units authorized	26,467	[3]28,611	22,973	-19.7
Value of nonresidential construction millions	$418.3	$440.7	$515.9	+17.1
Value of State road contract awards do	$237.1	$189.0	$310.0	+64.0
Shipments of portland and masonry cement to and within the State thousand short tons	1,654	1,729	1,687	-2.4
Nonfuel mineral production value:				
Total crude mineral value millions	$303.7	$346.8	$385.7	+11.2
Value per capita, resident population	$71	$80	$88	+10.0
Value per square mile	$7,189	$8,210	$9,131	+11.2

[p] Preliminary.

[1] Includes bituminous coal and oil and gas extraction.

[3] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

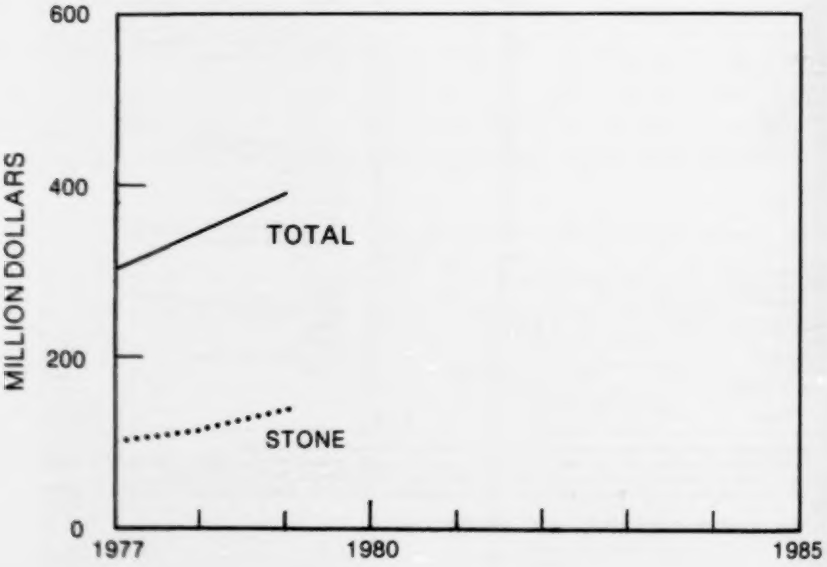

Figure 1.—Value of stone and total value of nonfuel mineral production in Tennessee.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Barite.—In 1978 and 1979, C. R. Wood Co. produced barite from its open pit mine and processed the ore at the company's plant in Loudon County near Sweetwater. The ground and crushed barite was shipped out of State and used primarily in the manufacture of paint. A. J. Smith Co. began mining barite at its open pit mine in Loudon County in 1979. As a result, State output rose nearly 32% in 1979 over 1978 levels.

Cement.—Portland and masonry cement was produced by four companies operating six plants. General Portland, Inc., operated at Chattanooga; Ideal Basic Industries, Inc., at Knoxville; Penn-Dixie Industries, Inc., at Richard City and Kingsport; and Gulf + Western Industries, Inc., at Nashville and Cowan.

Ready-mix companies were the largest purchasers of portland cement, followed by concrete product manufacturers, building material dealers, government agencies, and highway contractors. The majority of the cement was shipped by rail and the remainder by truck.

In mid-1979, Penn-Dixie Industries, Inc., announced a $1 million expansion at its plant in Richard City. Five new 1,000-ton storage and loading silos are expected to improve shipments of cement to customers in a four-State area.

Table 4.—Tennessee: Portland cement salient statistics

(Short tons)

	1978	1979
Number of active plants	6	6
Production	1,518,090	1,394,276
Shipments from mills:		
Quantity	1,568,188	1,334,596
Value	$60,223,413	$57,145,532
Stocks at mills, Dec. 31	111,714	133,436

Table 5.—Tennessee: Masonry cement salient statistics

(Short tons)

	1978	1979
Number of active plants	5	5
Production	238,536	173,234
Shipments from mills:		
Quantity	217,032	169,835
Value	$10,443,165	$8,600,241
Stocks at mills, Dec. 31	16,137	15,445

In August 1979, Gulf + Western commissioned the first of four 295-foot-long cement barges being built by the Nashville Bridge Co. Construction of the remaining three was expected to be completed sometime in 1980. The new vessels, valued at $1 million each, will be used mainly on the Cumberland, Tennessee, Mississippi, and Ohio Rivers.

Clays.—During 1978 and 1979, Tennessee produced ball clay, fuller's earth, common clay, and a small amount of bentonite.

Tennessee ranked first in the Nation in the production of ball clay, producing 77% of the U.S. total. Production increased 5% and 21% in 1978 and 1979, respectively, compared to 1977 output. Four companies produced ball clay: Kentucky-Tennessee Clay Co., Cyprus Industrial Minerals Co., H. C. Spinks Clay Co., and Old Hickory Clay Co. Principal uses were in the manufacture of pottery, floor and wall tile, sanitary ware, china dinnerware, catalysts (oil refining), ceramics, and electrical porcelain.

Tennessee ranked fifth in the production of fuller's earth, a clay with absorbent properties that make it useful as a purifier for mineral and vegetable oils, as a pet waste disposal medium, as an oil and grease absorber, and in specialized drilling muds. One company, Lowe's, Inc., produced fuller's earth in Henry County. A minor amount of bentonite was also produced in Henry County by H. C. Spinks.

Table 6.—Tennessee: Ball clay sold or used by producers, by kind and use

(Short tons)

Use	1977			1978			1979		
	Airfloat	Unprocessed	Total	Airfloat	Unprocessed	Total	Airfloat	Unprocessed	Total
Fine china and dinnerware	25,476	--	25,476	27,341	--	27,341	32,246	--	32,246
Electrical porcelain	W	W	7,150	W	W	23,698	W	W	32,179
Floor and wall tile, ceramic	W	W	33,254	W	W	90,912	W	W	99,410
Pottery	W	W	199,859	W	W	205,185	W	W	231,251
Sanitary ware	--	W	W	W	W	125,917	W	W	134,165
Other uses[1]	371,091	170,975	[2]301,803	326,433	237,499	118,296	366,348	256,834	126,197
Exports	32,043	28,243	60,886	36,018	34,944	70,962	68,690	37,999	106,689
Total	428,610	199,818	628,428	389,792	272,443	662,235	467,304	294,833	762,137

W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Includes common brick; catalysts (oil refining); china/dinnerware; crockery and other earthenware; fertilizers; fiberglass; firebrick, block, and shapes; floor and wall tile; (ceramic, 1977); flower pots; high-alumina refractories; kiln furniture; mortar and cement; paper coating (1977); paper filling (1977); pesticides and related products; pet waste absorbent (1977); rubber; asphalt tile; waterproofing and sealing; and uses indicated by symbol W.

[2] Incomplete total; remainder included in individual totals.

Table 7.—Tennessee: Common clay sold or used by producers, by use

(Short tons)

Use	1977	1978	1979
Brick	543,704	560,725	479,281
Portland cement	197,236	230,857	217,788
Concrete block	205,728	196,215	--
Structural concrete	3,000	--	--
Total	949,668	987,797	697,069

Common clay and shale was produced by 8 companies at 14 open pits in 9 counties. Leading counties in order of descending output were Hamilton, Sullivan, Davidson, and Knox. Principal producers were General Shale Products Corp., W. G. Bush and Co., and General Portland, Inc. Common clay was used primarily in the production of face and common brick, portland cement, concrete block, and structural concrete.

Table 8.—Tennessee: Clays sold or used by producers

Year and type	Quantity (short tons)	Value	
		Total	Average per ton
1977:			
Ball clay	628,428	$12,511,168	$19.91
Common clay and shale	949,668	1,457,249	1.53
Total	1,578,096	13,968,417	XX
1978:			
Ball clay	662,235	14,838,557	22.41
Common clay and shale	987,797	2,816,753	2.85
Total	1,650,032	17,655,310	XX
1979:			
Ball clay	762,137	19,663,038	25.80
Common clay and shale	697,069	1,304,844	1.87
Total	1,459,206	20,967,882	XX

XX Not applicable.

Fluorspar.—In 1978, the United States Borax & Chemical Corp. began sinking an exploratory shaft on its fluorite-barite-zinc ore body near Sweetwater, in Monroe and McMinn Counties, in eastern Tennessee. Since 1973, the company has drilled more than 210 exploratory holes in a 300-square-mile area; this disclosed a deposit of 26 million tons containing 15% to 35% CaF_2. A 600-foot shaft was driven into the ore body for exploration; development drifting, underground core drilling, and metallurgical test work were also undertaken. The project was still under evaluation at the end of 1979.

Graphite.—Synthetic graphite was recovered from petroleum coke by Union Carbide Corp. at its plant near Columbia in Maury County. Primary use of the graphite was in the manufacture of electric furnace electrodes.

Lime.—Quicklime and hydrated lime was produced by Williams Lime Manufacturing Co. in Knoxville, Knox County, while Bowaters Southern Paper Corp. produced only quicklime at Calhoun in McMinn County. In 1979, Tenn-Luttrell Lime Co. began producing quicklime at a new lime plant near Knoxville. The plant features an 800-short-ton-per-day preheater kiln. The lime was used principally in pulp and paper processing, water purification, and lithium manufacture.

Perlite.—Chemrock Corp. expanded perlite at its Nashville plant. The product was principally used as a filter aid, in concrete and plaster aggregates, as insulation, and in horticulture aggregate.

Phosphate Rock.—Tennessee ranked fourth in the Nation in tonnage and value of phosphate rock in 1979. The ore was produced from surface mines in four counties (Hickman, Maury, Giles, and Williamson) in the Columbia-Mt. Pleasant district of south-central Tennessee. Major producers were Monsanto Industrial Chemical Co., Hooker Chemical Co., and Stauffer Chemical Co. Thirteen surface mine permits were issued in 1978 and 1979 covering 3,833 acres. The State approved the reclamation of 1,059 acres.

Although production of marketable concentrates was down almost 13% in 1978, output rebounded in 1979 to about 1977 levels. Average grade of the ore mined was nearly 21% P_2O_5. Most of the rock was reduced to elemental phosphorus, and subsequently was converted into a wide variety of industrial chemicals.

Table 9.—Tennessee: Phosphate rock sold or used by producers

Year	Rock	P_2O_5 content	Value	
	(thousand metric tons)		Total (thousands)	Average per ton
1975	2,171	560	$29,921	$13.78
1976	1,731	448	15,326	8.85
1977	1,723	436	14,064	8.16
1978	1,688	434	13,833	8.19
1979	2,140	545	17,008	7.95

Table 10.—Tennessee: Production of phosphate rock

Year	Mine production (thousand metric tons)		Marketable production (thousand metric tons)		Value, marketable production	
	Rock	P_2O_5	Rock	P_2O_5	Total (thousands)	Average per ton
1975	3,676	733	2,078	533	$28,803	$13.86
1976	3,022	618	1,633	421	14,541	8.90
1977	3,307	665	1,747	442	14,253	8.16
1978	3,062	646	1,709	442	14,047	8.22
1979	3,211	670	1,873	467	14,770	7.88

Pyrite.—Tennessee led the Nation in pyrite production in both 1978 and 1979. The only producer in the State was Cities Service Co. at Copperhill, Polk County. Pyrite was recovered by flotation from sulfide ore produced at the company's three underground mines. Output rose in both 1978 and 1979. Concentrates from the plant yielded primarily industrial chemicals (mostly sulfuric acid) and iron pellets. Some of the sulfuric acid was used at the plant to produce other chemicals, and the remainder was sold to industry throughout the Eastern United States.

Sand and Gravel.—Sand and gravel was produced by 81 companies in 34 counties throughout the State. Approximately 39% of the State's 11.2 million tons in 1979 came from the Shelby County-Memphis area in the western part of the State. Principal uses were for roadbase, concrete and asphaltic aggregate, and fill.

Industrial sand used in the manufacture of glass in Nashville, Chattanooga, and

Kingsport was produced in Benton, Carroll, and Franklin Counties. Campbell and Shelby Counties produced other industrial sands for use in silicon carbide products and ferrosilicon, for coal-washing, sandblasting, and traction.

Table 11.—Tennessee: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,004	$6,890	$2.29	3,916	$9,266	$2.37	3,164	$8,803	$2.78
Plaster and gunite sands	NA	NA	NA	264	774	2.93	191	664	3.48
Concrete products	2,008	4,812	2.40	324	1,018	3.14	265	825	3.11
Asphaltic concrete	1,837	3,993	2.17	1,994	4,183	2.10	2,062	5,180	2.51
Roadbase and coverings	4,103	7,127	1.74	3,868	7,463	1.93	3,644	7,356	2.02
Fill	779	852	1.09	706	860	1.22	1,286	1,839	1.43
Snow and ice control	NA	NA	NA	W	W	3.83	W	W	3.05
Other uses	292	578	1.98	191	454	2.37	165	634	3.84
Total[1] or average	12,023	24,253	2.02	11,260	24,020	2.13	10,778	25,300	2.35

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Data may not add to totals shown because of independent rounding.

Table 12.—Tennessee: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	6,634	$13,711	$2.07	5,349	$11,355	$2.12	4,422	$10,462	$2.37
Gravel	5,390	10,542	1.96	5,914	12,662	2.14	6,356	14,838	2.33
Total[1] or average	12,023	24,253	2.02	11,260	24,020	2.13	10,778	25,300	2.35
Industrial:									
Sand	750	4,945	6.59	698	4,613	6.61	402	3,578	8.91
Gravel	--	--	--	--	--	--	30	177	5.96
Total[1] or average	750	4,945	6.59	698	4,613	6.61	431	3,755	8.70
Grand total[1] or average	12,773	29,197	2.29	11,960	28,630	2.39	11,210	29,056	2.59

[1] Data may not add to totals shown because of independent rounding.

Table 13.—Tennessee: Sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1977			1978			1979		
	Number of mines	Quantity	Value	Number of mines	Quantity	Value	Number of mines	Quantity	Value
Anderson	1	4	6	--	--	--	--	--	--
Benton	4	1,466	5,462	8	1,651	5,018	7	1,121	2,363
Campbell	2	73	W	2	W	355	2	W	W
Carroll	--	--	--	--	--	--	1	W	W
Coffee	1	326	896	1	379	W	2	W	W
Cumberland	4	182	358	2	153	267	1	150	263
Decatur	1	237	403	2	W	W	2	W	W
Dyer	2	W	W	4	354	640	3	135	217
Fayette	2	59	99	3	73	118	3	85	108
Fentress	--	--	--	1	W	126	1	57	85
Giles	--	--	--	1	90	135	1	250	250
Hardeman	2	W	W	2	W	W	1	1	1
Hardin	3	117	192	3	203	379	4	153	249
Henry	2	W	W	3	265	483	3	250	457
Humphreys	1	W	W	1	280	W	1	254	610
Knox	3	298	933	2	W	W	2	W	W
Lauderdale	6	77	125	4	56	92	4	56	92
Lawrence	1	15	15	1	12	18	1	12	18
Loudon	2	W	W	--	--	--	--	--	--
McNairy	2	W	W	3	147	345	2	W	W
Madison	3	95	158	3	119	180	2	W	W
Marion	1	W	W	1	W	W	1	W	314
Obion	5	325	640	5	370	799	5	414	817
Perry	1	239	406	--	--	--	--	--	--
Shelby	16	5,776	10,366	17	4,076	7,763	16	4,406	9,785
Stewart	1	W	W	1	257	W	1	259	908
Tipton	6	535	919	5	604	1,269	5	388	968
Union	1	45	90	1	36	90	1	36	90
Wayne	1	W	136	1	W	W	1	W	W
Undistributed[1]	15	2,906	7,994	15	2,835	10,555	14	3,182	11,462
Total[2]	89	12,773	29,197	92	11,960	28,630	87	11,210	29,056

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes Franklin, Greene, Hamilton, McMinn, Putnam, Roane, Sevier, Unicoi, and Washington Counties, and data indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Silicon Carbide.—The Carborundum Co. produced silicon carbide at its Jacksboro plant in Campbell County in 1978 and 1979. The product was used for abrasives, refractories, and metallurgical applications. The plant closed in October 1979, affecting about 90 jobs. The main reason for the closing was the cost of power from the Tennessee Valley Authority, which had increased nearly 600% since 1970.

Stone.—Stone again was the most valuable nonfuel mineral commodity produced in the State in 1978 and 1979. Crushed limestone accounted for more than 99% of the total stone production in both years; dimension sandstone and marble accounted for the remainder. Crushed stone was produced in 64 counties, in central and eastern Tennessee, by 79 companies operating 129 quarries. Seven companies produced over 1 million tons each, and accounted for nearly 60% of the entire State's output. Leading producers were Vulcan Materials Co., Asarco, Ralph Rogers and Co., Inc., Koppers Co., and Hoover, Inc. Principal uses for the crushed stone were for roadbase, concrete and bituminous aggregate, and agricultural limestone.

Dimension sandstone and marble were produced at eight quarries for use as cut stone, house stone veneer, dressed flagging, and other uses. Production remained essentially the same in 1978 and 1979. Leading producers were John J. Craig Co., Turner Stone Co., and Crab Orchard Stone Co., Inc.

Vermiculite.—Construction Products Div. of W. R. Grace & Co. expanded crude vermiculite at its Nashville plant during the biennium. Output declined slightly in 1978, but rebounded again in 1979. Principal uses were for block insulation, lightweight concrete aggregate, horticulture, plaster aggregate, and loose fill.

Table 14.—Tennessee: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	2,878	7,399	2,600	7,369	2,068	5,767
Poultry grit and mineral food	537	2,207	387	1,573	444	2,030
Concrete aggregate	[r]5,220	[r]12,055	5,814	14,440	5,585	16,375
Bituminous aggregate	3,888	8,686	4,461	11,233	3,681	10,357
Macadam aggregate	1,853	4,197	2,257	5,555	2,071	5,698
Dense-graded roadbase stone	[r]13,332	[r]30,413	13,386	33,077	14,810	41,280
Surface treatment aggregate	1,664	3,825	1,776	4,382	1,402	3,984
Other construction aggregate and roadstone	7,683	17,046	9,251	22,955	10,062	29,092
Riprap and jetty stone	483	962	525	1,217	855	2,517
Railroad ballast	266	505	207	435	237	581
Filter stone	259	638	112	302	64	190
Manufactured fine aggregate (stone sand)	1,015	2,988	1,286	4,370	1,273	4,178
Terrazzo and exposed aggregate	W	W	4	143	--	--
Cement manufacture	1,841	4,692	2,133	5,365	1,619	4,572
Lime manufacture	W	W	78	156	W	W
Glass manufacture	W	W	W	W	246	960
Acid neutralization	231	W	231	W	4	143
Sulfur dioxide	66	173	W	W	W	W
Other uses[2]	682	3,411	953	4,698	1,297	6,004
Total[3]	41,897	99,196	45,460	117,271	45,718	133,727

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone and marble.

[2] Includes stone used in mine dusting, asphalt filler, whiting, other fillers or extenders, drain fields, unspecified uses, and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 15.—Tennessee: Dimension stone[1] sold or used by producers, by use

Use	1977			1978			1979		
	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)
Dressed stone:									
Cut stone	1,944	25	352	W	W	W	W	W	W
House stone veneer	2,340	30	74	1,701	22	63	1,506	19	56
Flagging	75	1	13	64	1	16	46	1	11
Other uses[2]	9,050	106	502	10,450	124	956	10,436	124	932
Total	13,409	162	941	12,215	147	1,035	11,988	144	[3]1,000

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes marble and sandstone.

[2] Includes stone used in rough blocks, irregular-shaped stone, rubble, rough flagging, and sawed stone.

[3] Data do not add to total shown because of independent rounding.

METALS

Aluminum.—Tennessee ranked fifth in the Nation in output of primary aluminum produced in 1979. Aluminum Company of America (Alcoa), Blount County, and Consolidated Aluminum Corp. (Conalco), Humphreys County, produced aluminum metal from imported ores.

Alcoa continued the plant-modernization program begun in 1977 to rebuild and expand its ingot casting operation, add new finishing equipment, and modernize hot and cold rolling facilities.

Copper.—Output of copper increased substantially in 1978 and remained essentially the same in 1979. A company strike in 1977 severely curtailed output in that year. Cities Service Co., the State's only producer in 1978, operated three underground mines (Boyd, Callaway, and Cherokee), an open pit mine, and a flotation plant at its Copperhill operations in Polk County. Ore was separated into copper, pyrite, and zinc concentrates.

Table 16.—Tennessee: Mine production (recoverable) of gold, silver, copper, and zinc

	1977	1978	1979
Mines producing: Lode	11	9	9
Material sold or treated:			
Ore:			
Copper-zinc thousand metric tons	1,134	1,837	1,901
Zinc do	3,397	3,292	3,256
Total do	4,531	5,129	5,157
Production:			
Quantity:			
Gold troy ounces	13	W	--
Silver do	60,246	W	W
Copper metric tons	5,313	11,289	W
Zinc do	82,044	87,906	85,119
Value:			
Gold thousands	$2	W	--
Silver do	$278	W	W
Copper do	$8,266	$16,550	W
Zinc do	$62,221	$60,078	$69,995
Total do	$70,767	W	W

W Withheld to avoid disclosing company proprietary data.

Ferroalloys.—Tennessee ranked second in the Nation in output of ferroalloys in 1978 and 1979. In both years, six companies produced nearly 250,000 short tons of ferrophosphorus, ferrosilicon, ferromanganese, and ferrochromium. Principal uses were as additives and alloying elements in the manufacture of various steel products.

In September 1979, the Roane Electric Furnace Co., Inc., plant at Rockwood was purchased from Engelhard Minerals & Chemicals Corp. by Roane, Ltd., a subsidiary of South African Manganese Amcor, Ltd. (SAMANCOR), the world's largest ferromanganese smelter.

Gold.—A small amount of gold was produced as a byproduct from Cities Service Co.'s copper-refining operations at Copperhill in 1978. No production was reported in 1979.

Iron.—Cities Service Co. produced iron sinter as a byproduct of the processing of pyrite and copper concentrates at Copperhill in Polk County. The product was sold and shipped to the iron and steel industry. In early 1979, the company closed its iron pellet facility because of poor operating reliability and overseas competition.

Manganese.—Foote Mineral Co. continued production of electrolytic manganese at its plant in New Johnsonville. Although high production levels were maintained for most of 1979, operations were reduced to two-thirds capacity in November because of reduced sales and inventory accumulation.

Rare Earths and Thorium.—Davison Specialty Chemical Co., a subsidiary of W. R. Grace & Co., processed monazite and a minor amount of bastnäsite concentrates at its Chattanooga plant. Thorium-containing residues were extracted from domestic and imported monazite during the refining of rare earths.

Silver.—Silver was recovered from concentrates produced during copper refining at the Cities Service Co.'s operations in Polk County.

Titanium.—E. I. du Pont de Nemours & Co., Inc., continued production of titanium dioxide pigment at its New Johnsonville plant from ilmenite and rutile concentrates mined in other States. This facility, the largest of its type in the United States, produced a major portion of the firm's titanium dioxide.

Zinc.—Tennessee ranked first in the Nation in value and output of zinc in both 1978 and 1979. In 1978, there were 9 operating mines, while there were 11 in 1979. These mines were located in the eastern, central, and southeastern part of the State.

In the Mascot-Jefferson City zinc district in the eastern part of the State, Asarco operated the Young and Immel mines in 1978-79. In 1979, production was resumed at Asarco's two other mines (New Market and Coy), which had been closed since late 1977. New Jersey Zinc Co. operated the Jefferson City mine in the same district, and the Idol mine in the Copper Ridge district, Grainger County, during 1978 and 1979, while U.S. Steel produced at the Zinc Mine Works.

In the middle Tennessee zinc district, Jersey Miniere Zinc Co. operated the Elmwood mine during 1978-79. This operation is a joint venture of New Jersey Zinc Co., a wholly owned subsidiary of Gulf + Western Industries, and Union Miniere S.A. of Belgium. In 1979, the company was still developing the Gordonsville mine and completed the construction of a 9,000-short-ton-per-day concentrator at the mine site. A third mine was expected to be developed near Stonewall. All three mines are expected to provide concentrate for the new zinc refinery built by the firm at Clarksville.

Table 17.—Tennessee: Tenor of zinc ore milled and concentrates produced

		1978	1979
Total material	metric tons	3,291,988	3,256,311
Metal content of ore:[1] Zinc	percent	2.55	2.50
Concentrates produced and average content:			
Zinc	metric tons	151,138	139,206
Recovery ratio	percent	4.59	4.27
Average zinc content	do	62.31	63.39

[1] Figure represents metal content of crude ore only as contained in the concentrate.

The new electrolytic zinc refinery, which came on line in 1978, was the first to be built in the United States since 1941. The refinery, rated at a capacity of 90,000 short tons per year, produces Special High Grade zinc directly by melting cathode sheets and casting it into slabs, blocks, and special shapes. Numerous alloys are also produced, including High Grade, Controlled Lead, and Prime Western grades. Pure cadmium (99.95% minimum) and sulfuric acid are also produced.

In the Ducktown district in southeastern Tennessee, Cities Service Co. continued recovering zinc sulfide from its three underground mines. Ore was processed at the nearby Copperhill plant.

In other zinc-related activities, Carthage Zinc Co., a joint venture between St. Joe Minerals Corp. and Freeport Minerals Co., completed a 1,150-foot exploration shaft in 1979 near Carthage (Smith Zinc Property). Results were being evaluated by the company. In 1979, New Jersey Zinc Co. continued development of the Beaver Creek mine where mining is expected to begin in early 1980.

Table 18.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum smelters:			
Aluminum Company of America	Box 158 Alcoa, TN 37701	Plant	Blount.
Consolidated Aluminum Corp	1102 Richmond St. Jackson, TN 38301	do	Humphreys.
Barite:			
A. J. Smith Co	Route 3 Sweetwater, TN 37874	Open pit mine	Loudon.
C. R. Wood Co., Inc	Box 284 Sweetwater, TN 37874	do	Do.
Cement:			
General Portland, Inc.[1]	1300 American National Bank Bldg. Chattanooga, TN 37402	Plant	Hamilton.
Gulf + Western Industries, Inc. (Marquette Cement Co.)	First American Center Nashville, TN 37238	Plants	Davidson and Franklin.
Ideal Basic Industries, Inc	Box 6238 Knoxville, TN 37914	Plant	Knox.
Penn-Dixie Industries, Inc	60 East 42d St. New York, NY 10017	Plants	Marion and Sullivan.
Clays:			
W. G. Bush and Co	1136 2d Ave. North Nashville, TN 37208	Pits and plants	Davidson and Weakley.
Cyprus Industrial Mineral Co	Box 111 Gleason, TN 38229	do	Carroll and Weakley.
General Shale Products, Inc	Box 3547 CRS Johnson City, TN 37601	do	Anderson, Hamilton, Knox, Sullivan, Washington.
Kentucky-Tennessee Clay Co	Box 449 Mayfield, KY 42066	do	Carroll, Gibson, Henry, Weakley.

See footnotes at end of table.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

[2] Chief geologist, Tennessee Division of Geology, Knoxville, Tenn.

Table 18.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Clays —Continued			
Lowe's, Inc	Box 819 Paris, TN 38242	Pits and plants	Henry.
Old Hickory Clay Co	Box 188 Gleason, TN 38229	do	Henry and Weakley.
H. C. Spinks Clay Co., Inc	Box 820 Paris, TN 38242	do	Carroll, Henry, Weakley.
Copper:			
Cities Service Co.[2]	Copperhill, TN 37317	Underground mines and plant.	Polk.
Ferroalloys:			
Chromium Mining and Smelting Co.	Box 28538 Memphis, TN 38128	Plant	Shelby.
Hooker Chemicals & Plastics Corp.	Box 591 Columbia, TN 38401	do	Maury.
Monsanto Industrial Chemical Co	Columbia, TN 38401	do	Do.
Roane Electric Furnace Co., Inc	Box 298 Rockwood, TN 37854	do	Roane.
Stauffer Chemical Co	Box 472 Mt. Pleasant, TN 38474	do	Maury.
Tennessee Metallurgical Corp	818 Hamilton Bank Bldg. Chattanooga, TN 37402	do	Marion.
Graphite, artificial:			
Union Carbide Corp	Box 513 Columbia, TN 38401	do	Maury.
Lime:			
Bowaters Southern Paper Corp	Calhoun, TN 37309	do	McMinn.
Tenn-Luttrell Lime Co	Box 69 Luttrell, TN 37779	do	Union.
Williams Lime Manufacturing Co	Box 2286 Knoxville, TN 37901	do	Knox.
Perlite, expanded:			
Chemrock Corp	Osage St. Nashville, TN 37208	do	Davidson.
Phosphate rock:			
Hooker Chemicals & Plastics Corp.[3]	Box 591 Columbia, TN 38401	do	Maury.
Monsanto Industrial Chemical Co.[3]	Columbia, TN 38401	do	Do.
Stauffer Chemical Co.[3]	Box 472 Mt. Pleasant, TN 38474	do	Do.
Sand and gravel:			
Camden Gravel Co	Box 207 Camden, TN 38320	Pit	Benton.
Clyde Owen Sand and Gravel, Inc	10636 Shelton Rd. Collierville, TN 38017	Pits	Shelby.
Memphis Stone and Gravel Co	Box 38269 Germantown, TN 38138	do	Benton and Shelby.
Standard Construction Co., Inc	Box 38289 Germantown,TN 38138	do	Shelby.
Stone:			
American Limestone Co	Box 2389 Knoxville, TN 37901	Quarries	Jefferson, Knox, Sullivan.
Hoover, Inc	Box 7201 Nashville, TN 37210	do	Davidson and Rutherford.
Koppers Co. (Stoneman, Inc.)	Box 2098 Chattanooga, TN 37409	do	Bedford, Hamilton, Rutherford, Warren.
Ralph Rogers and Co., Inc. (Mid-South Pavers, Inc.)	720 Argyle Ave. Nashville, TN 37203	do	Various.
Vulcan Materials Co	Box 7 Knoxville, TN 37901	do	Do.
Vermiculite, exfoliated:			
W. R. Grace & Co	4061 Powell Ave. Nashville, TN 37204	Plant	Davidson.
Zinc:			
ASARCO Incorporated[4]	Mascot, TN 37806	Underground mines and plant.	Jefferson and Knox.
Jersey Miniere Zinc Co	Elmwood, TN 38560	Underground mine	Smith.
The New Jersey Zinc Co	Box 32 Jefferson City, TN 37760	do	Jefferson.
United States Steel Corp	Jefferson City, TN 37760	do	Do.

[1] Also clays.
[2] Also gold, silver, zinc, pyrites.
[3] Also ferroalloys.
[4] Also stone.

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The Mineral Industry of Texas

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Bureau of Economic Geology, the University of Texas at Austin, for collecting information on all nonfuel minerals.

By Murphy E. Hawkins[1] and L. E. Garner[2]

During the biennium 1978-79, Texas ranked fifth among the States in the output of nonfuel mineral wealth. Total value of the 20 different mineral commodities produced in 1979 was $1,406 million, compared with $1,154 million output of 24 mineral commodities in 1978. The State was the Nation's only producer of natural graphite and native asphalt and the leading producer of magnesium chloride and Frasch sul-

Table 1.—Nonfuel mineral production in Texas[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:						
Masonry thousand short tons	254	$13,095	290	$17,248	268	$15,593
Portland do.	8,482	331,758	8,808	401,220	9,353	475,836
Clays do.	[2]3,682	[2]11,465	4,189	19,818	3,871	21,533
Gem stones	NA	160	NA	170	NA	170
Gypsum thousand short tons	1,718	8,837	1,864	11,060	1,903	11,438
Helium (high purity) million cubic feet	--	--	32	1,132	70	2,447
Iron ore thousand long tons	W	W	W	W	W	W
Lime thousand short tons	1,612	49,965	1,408	48,882	1,507	59,520
Salt do.	10,941	53,264	9,100	49,153	11,283	67,602
Sand and gravel do.	55,495	133,420	56,925	149,599	52,846	167,076
Stone:						
Crushed do.	65,446	122,784	69,095	150,868	74,612	188,746
Dimension do.	27	3,922	28	4,192	17	3,636
Sulfur (Frasch) thousand metric tons	3,157	W	3,752	W	4,649	W
Talc and soapstone short tons	223,024	2,191	288,407	1,520	207,398	1,544
Combined value of asphalt (natural), clays (ball clay, fuller's earth, and kaolin, 1977), fluorspar, gold (1978), graphite, helium, (crude), iron ore, lead (1978), magnesium chloride, magnesium compounds, silver (1978), sodium sulfate, vermiculite (1977-78), zinc (1978), and values indicated by symbol W	XX	[r]304,432	XX	299,298	XX	391,027
Total	XX	[r]1,035,293	XX	1,154,160	XX	1,406,168

[r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes ball clay, fuller's earth, and kaolin; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Texas, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Archer	$18	$40	Stone.
Armstrong	W	W	Sand and gravel.
Atascosa	841	1,271	Do.
Bailey	--	W	Stone.
Bastrop	W	536	Clays.
Bell	3,426	4,385	Stone, sand and gravel.
Bexar	W	W	Cement, stone, lime, sand and gravel, clays.
Borden	W	W	Sand and gravel.
Bosque	W	W	Lime, stone.
Bowie	628	643	Sand and gravel.
Brazoria	130,613	W	Magnesium chloride, salt, magnesium compounds, sand and gravel.
Brazos	W	W	Sand and gravel.
Brewster	W	W	Fluorspar, sand and gravel.
Brown	W	W	Stone, clays.
Burleson	134	W	Sand and gravel.
Burnet	W	W	Stone, graphite, sand and gravel.
Calhoun	W	W	Lime, stone.
Camp	W	W	Clays.
Cass	W	W	Iron ore.
Chambers	W	W	Salt, sand and gravel, clays.
Cherokee	W	547	Clays.
Clay	--	4	Stone.
Coke	W	W	Sand and gravel.
Coleman	W	W	Clays, stone.
Collin	W	W	Stone.
Colorado	35,395	31,471	Sand and gravel, stone.
Comal	W	W	Stone, lime, sand and gravel.
Comanche	W	W	Stone, clays.
Concho	192	--	
Cooke	W	W	Sand and gravel, stone.
Coryell	W	W	Do.
Crockett	420	410	Stone.
Crosby	W	W	Sand and gravel.
Culberson	W	W	Sulfur (Frasch), talc, stone.
Dallas	W	W	Cement, sand and gravel, stone, clays.
Deaf Smith	W	W	Lime.
Denton	1,426	1,594	Sand and gravel, clays.
Duval	W	W	Salt, sand and gravel.
Eastland	W	W	Clays, stone, sand and gravel.
Ector	W	W	Cement, stone.
Ellis	W	W	Cement, stone, clays.
El Paso	W	W	Cement, stone, sand and gravel.
Falls	--	600	Stone.
Fannin	W	W	Sand and gravel.
Fayette	W	W	Clays, sand and gravel.
Fisher	W	W	Gypsum, clays.
Fort Bend	15,761	15,245	Sulfur, salt, clays, sand and gravel.
Freestone	W	W	Stone, clays.
Frio	W	--	
Gaines	W	W	Sodium sulfate.
Galveston	W	W	Sand and gravel, clays.
Gillespie	W	W	Gypsum, sand and gravel, stone.
Gray	W	W	Sand and gravel.
Grayson	589	W	Stone.
Gregg	478	364	Sand and gravel.
Grimes	30	--	
Guadalupe	W	W	Sand and gravel, clays.
Hall	263	263	Sand and gravel.
Hansford	W	W	Helium, stone.
Hardeman	W	W	Gypsum.
Hardin	W	W	Sand and gravel.
Harris	99,177	120,849	Cement, sand and gravel, lime, salt, clays, stone.
Harrison	W	W	Clays, sand and gravel.
Hays	1,852	W	Cement, sand and gravel.
Henderson	W	W	Sand and gravel, iron ore, clays.
Hidalgo	W	W	Stone, sand and gravel.
Hill	W	W	Lime, stone.
Hockley	352	352	Stone.
Hood	W	W	Do.
Houston	W	W	Sand and gravel.
Howard	W	W	Sand and gravel, stone.
Hudspeth	W	W	Talc, stone, gypsum.
Hunt	19	--	
Hutchinson	W	W	Sand and gravel, salt.
Jack	W	W	Stone.
Jefferson	W	W	Sulfur (Frasch), salt, sand and gravel.
Jim Wells	W	W	Stone.
Johnson	W	W	Lime, sand and gravel, stone.
Jones	329	W	Sand and gravel, stone.

See footnotes at end of table.

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Table 2.—Value of nonfuel mineral production in Texas, by county[1] —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Karnes	W	W	Stone.
Kaufman	$1,280	$1,310	Do.
Kent	4	4	Sand and gravel.
Kerr	W	W	Do.
Kimble	149	109	Do.
Kleberg	--	30	Stone.
Lamar	W	W	Sand and gravel.
Lamb	W	W	Stone.
Lampasas	341	143	Sand and gravel.
La Salle	264	--	
Liberty	W	W	Sulfur (Frasch), sand and gravel.
Limestone	W	W	Clays, sand and gravel, stone.
Live Oak	W	W	Sand and gravel.
Llano	W	W	Stone, vermiculite.
Lubbock	W	219	Stone, sand and gravel.
Lynn	W	W	Stone.
McCulloch	7,921	W	Sand and gravel, stone.
McLennan	24,536	W	Cement, sand and gravel, stone, clays.
McMullen	702	389	Stone.
Marion	W	W	Clays.
Mason	111	125	Stone.
Matagordo	W	W	Salt.
Maverick	W	W	Sand and gravel.
Medina	W	W	Sand and gravel, clays.
Midland	W	826	Stone.
Mills	12	9	Do.
Mitchell	W	--	
Montague	W	W	Stone.
Montgomery	W	61	Sand and gravel.
Moore	W	W	Helium.
Morris	W	W	Iron ore.
Motley	W	W	Sand and gravel.
Nacogdoches	W	W	Clays.
Navarro	W	W	Do.
Newton	W	--	
Nolan	25,324	W	Cement, gypsum, stone, sand and gravel, clays.
Neuces	W	W	Cement, lime, sand and gravel.
Oldham	1,268	1,876	Sand and gravel, stone.
Orange	W	W	Cement, sand and gravel, clays.
Palo Pinto	W	W	Sand and gravel, clays.
Parker	W	W	Stone, clays, sand and gravel.
Pecos	W	W	Sulfur (Frasch), sand and gravel.
Polk	126	184	Sand and gravel.
Potter	11,552	13,792	Cement, stone, sand and gravel, clays.
Presidio	W	W	Sand and gravel.
Randall	802	W	Stone.
Reeves	W	W	Sand and gravel.
Runnels	W	W	Do.
Rusk	W	W	Clays.
San Patricio	W	W	Stone, clays.
San Saba	W	W	Stone.
Scurry	W	259	Do.
Smith	W	1,467	Sand and gravel, clays, stone.
Somervell	W	W	Sand and gravel.
Starr	W	W	Do.
Stephens	W	W	Stone.
Stonewall	W	W	Gypsum.
Sutton	2,098	--	
Tarrant	W	W	Cement, sand and gravel, stone.
Taylor	W	W	Stone, sand and gravel, clays.
Terry	W	W	Sodium sulfate.
Tom Green	W	W	Stone.
Travis	W	W	Lime, sand and gravel, stone.
Upshur	246	4	Sand and gravel.
Uvalde	W	W	Stone, asphalt, sand and gravel.
Val Verde	W	389	Sand and gravel.
Van Zandt	W	W	Salt, clays.
Victoria	6,092	8,506	Sand and gravel.
Walker	W	W	Stone, clays, sand and gravel.
Waller	19	W	Sand and gravel.
Ward	W	1,166	Do.
Webb	W	W	Sand and gravel, stone.
Wharton	W	W	Sulfur (Frasch).
Wichita	W	W	Sand and gravel, stone.
Williamson	10,657	W	Stone, sand and gravel.
Wilson	W	W	Clays.
Winkler	--	W	Salt.
Wise	W	W	Stone, sand and gravel, clays.
Wood	W	W	Clays, sand and gravel.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Texas, by county[1] —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Yoakum	W	W	Salt.
Young	W	W	Stone, sand and gravel.
Undistributed[2]	[r]$649,840	$944,702	
Total	[r]1,035,293	1,154,160	

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] The following counties are not listed because no nonfuel mineral production was reported: Anderson, Andrews, Angelina, Aransas, Austin, Bandera, Baylor, Bee, Blanco, Briscoe, Brooks, Caldwell, Callahan, Cameron, Carson, Castro, Childress, Cochran, Collingsworth, Cottle, Crane, Dallam, Dawson, Delta, De Witt, Dickens, Dimmit, Donley, Edwards, Erath, Floyd, Foard, Franklin, Garza, Glasscock, Goliad, Gonzales, Hale, Hamilton, Hartley, Haskell, Hemphill, Hopkins, Irion, Jackson, Jasper, Jeff Davis, Jim Hogg, Kendall, Kenedy, King, Kinney, Knox, Lavaca, Lee, Leon, Lipscomb, Loving, Madison, Martin, Menard, Milam, Ochiltree, Panola, Parmer, Rains, Reagan, Real, Red River, Refugio, Roberts, Robertson, Rockwall, Sabine, San Augustine, San Jacinto, Schleicher, Shackelford, Shelby, Sherman, Sterling, Swisher, Terrell, Throckmorton, Titus, Trinity, Tyler, Upton, Washington, Wheeler, Wilbarger, Willacy, Zapata, and Zavala.

[2] Includes gem stones and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Texas business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	5,776.0	6,012.0	6,244.0	+3.9
Unemployment	do	309.0	289.0	263.0	-9.0
Employment (nonagricultural):					
Mining[1]	do	159.3	182.7	199.3	+9.1
Manufacturing	do	893.5	962.8	1,022.5	+6.2
Contract construction	do	345.8	381.8	419.8	+10.0
Transportation and public utilities	do	308.8	329.6	351.7	+6.7
Wholesale and retail trade	do	1,210.5	1,297.6	1,375.4	+6.0
Finance, insurance, real estate	do	276.5	295.3	314.5	+6.5
Services	do	836.9	898.1	961.3	+7.0
Government	do	875.5	923.7	958.7	+3.8
Total nonagricultural employment[1]	do	4,906.8	5,271.6	5,603.2	+6.3
Personal income:					
Total	millions	$88,283	$100,804	$115,721	+14.8
Per capita		$6,894	$7,746	$8,649	+11.7
Construction activity:					
Number of private and public residential units authorized		136,212	[2]169,743	150,097	-11.6
Value of nonresidential construction	millions	$1,900.8	$2,793.8	$3,536.0	+26.6
Value of State road contract awards	do	$440.0	$822.0	$765.0	-6.9
Shipments of portland and masonry cement to and within the State	thousand short tons	8,117	8,878	8,996	+1.3
Nonfuel mineral production value:					
Total crude mineral value	millions	[r]$1,035.3	$1,154.2	$1,406.2	+21.8
Value per capita, resident population		[r]$81	$89	$105	+17.9
Value per square mile		[r]$3,873	$4,317	$5,260	+21.8

[p]Preliminary. [r]Revised.

[1] Includes oil and gas extraction.

[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

fur. Texas was also among the leaders in output of cement, clays, fluorspar, gypsum, lime, salt, sand and gravel, stone, and talc.

Legislation and Government Programs.—In 1979, the 66th Texas legislature passed House Bill 1424 that allowed the State, acting through the Surface Mining Division of the Texas Railroad Commission (TRRC), to petition the U.S. Department of the Interior for authority to administer the Federal Surface Mining Control and Reclamation Act of 1977 in Texas.

By yearend 1979, the Secretary of the Interior had designated 31 schools and universities as State Mining and Mineral Resources and Research Institutes to share $5.4 million under Title III of the Surface Mining Control and Reclamation Act of 1977 (Public Law 95-87). The act provides for annual allotments to one designated institute in each participating State through fiscal 1984 and for research and scholarship grants to each institute. The institutes are to establish training programs in mining and minerals extraction and provide scholarships and fellowships. Each institute initially received a basic grant of $110,000 and $160,000 for scholarships and fellowships.

The University of Texas (UT) at Austin was designated the Institute in Texas during 1978. Established as an administrative unit of UT, Austin's Bureau of Economic Geology, the institute included a cooperative research program with the Texas A&M University System.

The Bureau of Economic Geology, UT at Austin, received a grant of $99,585 from the Federal Bureau of Mines for developing a Mineral Industry Location System for Texas. Also, as part of the Bureau's continuing research effort in the fields of the environmental quality and health and safety aspects of mining, the university received a $52,512 grant from the Federal Bureau of Mines to develop an environmentally attractive leachant for in situ uranium mining, and Texas Tech University at Lubbock received an $83,657 grant to conduct biomechanics research in low coal.

A number of minerals are brought to Texas by ship. Upon executive order of the Governor, the Deepwater Port Authority, established in 1977 by the 65th Legislature, began operation in February 1978. Although the port authority is empowered to issue bonds for constructing a deepwater port off the Texas coast, the State cannot guarantee payment of the bonds and is exempt from liability for any damages that might occur.

In 1978, Governor Briscoe appointed 15 members to the Advisory Committee of the Natural Resources Council. The committee conducts public hearings on matters involving Texas natural resources and provides advice to the council. The Governor also appointed two new industry members to the 11-member Texas Mining Council. In 1979, Governor Clements appointed 7 members to the Mining Council to replace members whose terms had expired. The Mining Council advises the Governor on all matters related to mining activity in the State.

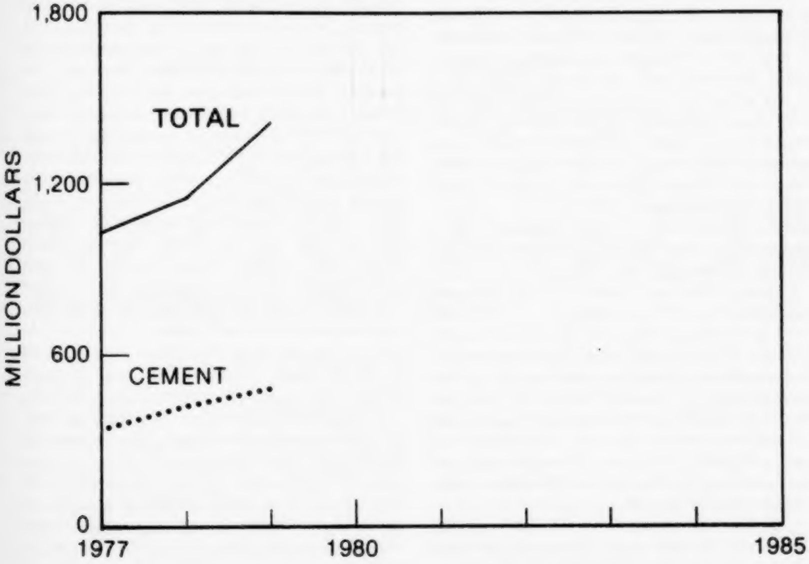

Figure 1.—Value of cement and total value of nonfuel mineral production in Texas.

To meet the requirements of the Federal Clean Air Act of 1977 (Public Law 95-95), the Texas Air Control Board amended its regulation pertaining to new construction or modification permits. The amended rules require that before a new plant can be built in an area with a pollution level higher than the acceptable guidelines, certain conditions must be met; including the reduction of existing emissions in the area in an amount greater than will result from the new facility. The State sought an exemption from this Environmental Protection Agency (EPA) requirement in December 1977, but the request was denied.

The Texas Energy Advisory Council authorized 33 energy research and development projects with a total cost of $3,025,688. Of this total, $967,646 will be allocated from the State's Energy Development Fund; and the remaining $2,058,042 will be funded from Federal, private, and other public sources. As part of its continuing research on the environmental aspects of mining, the Federal Bureau of Mines sponsored research at Texas A&M University to evaluate the potential impact of surface lignite mining on surface and groundwater quality in Texas.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Asphalt (Native).—Two companies continued to mine a naturally asphaltic-impregnated limestone in Uvalde County. Texas was the only producer of native asphalt that was used chiefly as a road-surfacing material.

Barite.—In 1978-79, six companies operating eight grinding plants processed barite from Arkansas, Missouri, Nevada, and from a number of foreign countries including India, Ireland, and mainland China. Virtually all of the ground barite was used for weighting material in well-drilling muds. No barite was mined in Texas; however, one company was evaluating barite deposits in the Seven Heart Gap area of the Apache Mountains in Hudspeth County.

At yearend 1979, three companies were constructing new barite grinding plants in Corpus Christi and Brownsville.

Cement.—Texas cement plants operated essentially at optimum capacity in 1978 and 1979 as supplies remained extremely tight. Fly ash from lignite and coal-fired steam electric powerplants was used to extend the cement supply. In addition to normal receipts of cement from neighboring States, cement shipments were received from Alabama, Florida, Ohio, and Pennsylvania, as well as from the Republic of Mexico, Spain, and the United Kingdom.

Thirteen companies operated 18 cement plants in 13 counties, Bexar (3 plants), Dallas, Ector, Ellis (2 plants), El Paso, Harris (3 plants), Hays, McLennan, Nolan, Nueces, Orange, Potter, and Tarrant Counties.

The Texas Cement Co., a division of Centex Corp., completed a new cement plant near Buda in Hays County. With a rated annual capacity of about 470,000 tons, the plant began shipping cement in September 1978. Originally the company had planned for the Buda plant to replace production from the 285,000-ton-per-year Centex plant in Corpus Christi which in turn would be used as a cement-distribution terminal and possibly converted to lime production. However, the continued strong cement market delayed this decision, and the Corpus Christi plant was continued in operation to help meet the demand, especially for oil-well-type cement. In 1978, Texas Industries, Inc., began constructing a new 550,000-ton-per-year cement plant near the community of Hunter in Comal County. When the Hunter plant is completed and begins production in early 1980, it could make Texas Industries the State's largest cement producer. In 1979, General Portland, Inc., began constructing a new 800,000-ton-per-year plant near New Braunfels in Comal County; and Lone Star Industries announced plans to build a 1-million-ton-per-year plant near Georgetown in Williamson County. The new cement plants are located in central Texas because it is one of the State's fastest growing areas and has an adequate supply of raw materials for manufacturing cement.

In mid-1978, the Southwestern Portland Cement Co. completed installing new equipment at its Odessa plant that doubled the clinker capacity. Also in mid-1978, Kaiser Cement Co. began an $11 million modernization program at the company's Longhorn plant in San Antonio which included closing three wet kilns and doubling the plant's existing dry-kiln capacity. Construction was completed and the plant was returned to full production later in 1979.

In 1978-79, the shift toward greater consumption of coal in the production of cement continued as Basic Industries, Inc., Gifford-Hill Portland Cement Co., Lone Star Industries, and Texas Industries, Inc., converted existing cement plants to burn solid fuels.

In August 1979, Texas Industries, Inc., opened a bituminous coal mine near Thurber, Erath County, to produce fuel for that company's cement and lightweight aggregate plants. Also in late 1979, Kaiser Cement Co. opened a bituminous coal mine in southern Coleman County to produce fuel for the company's San Antonio plant and for sales to other customers.

Table 4.—Texas: Portland cement salient statistics

(Short tons)

	1978	1979
Number of active plants	18	18
Production	8,623,674	9,069,950
Shipments from mills:		
Quantity	8,808,254	9,353,304
Value	$401,219,657	$475,835,879
Stocks at mills, Dec. 31	467,457	433,594

Table 5.—Texas: Masonry cement salient statistics

(Short tons)

	1978	1979
Number of active plants	11	11
Production	296,564	268,623
Shipments from mills:		
Quantity	289,543	267,765
Value	$17,248,369	$15,593,175
Stocks at mills, Dec. 31	18,650	27,173

Clays.—In 1978-79, common clay and shale made up over 90% of the total clay output in the State. Other kinds of clay produced included ball, bentonite, fire, fuller's earth, and kaolin. Ball clay was mined in Cherokee and Henderson Counties; bentonite in Fayette and Walker Counties; and fuller's earth in Gonzales and Fayette Counties. Fire clay was obtained in Bastrop, Cherokee, and Wood Counties; and kaolin was mined in Limestone County.

In June 1978, the Acme Brick Co. completed an expansion program at the Garrison brick plant increasing the productive capacity of the company's Panola County facility from 18 to 40 million brick per year.

Table 6.—Texas: Clays sold or used by producers, by kind

(Thousand short tons and thousand dollars)

Year	Ball clay		Bentonite		Fire clay		Common clay and shale		Total[1]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1975	55	467	W	W	34	271	3,995	7,593	4,248	13,411
1976	16	109	39	850	54	259	3,597	7,627	3,786	13,695
1977	W	W	40	974	56	278	3,586	10,213	3,810	16,272
1978	W	W	56	1,101	50	273	3,955	13,500	4,189	19,818
1979	W	W	66	3,242	58	725	3,610	11,548	3,871	21,533

W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Includes fuller's earth, kaolin, and data indicated by symbol W.

In 1978, Rio Clay Products began installing a new kiln and renovated other equipment before reopening the company's brick plant near Rio Grande City (Starr County) in March 1979. Also in 1979 Brazos Brick Co., a division of Michigan Brick, Inc., purchased the closed Reliance brick plant and clay pits in Mineral Wells, Palo Pinto County, and began constructing a new brick plant. With a productive capacity of 80 million brick per year, the plant is scheduled to begin production in the first quarter of 1980.

In late 1979, English China Clay's Ltd., a British firm, announced that it had acquired Southern Clay Products, Inc., for about $22 million. Southern Clay mines and processes bentonite and ball clay in the central and eastern parts of the State.

Fluorspar.—D & F Minerals Co. continued to mine metallurgical-grade fluorspar from its La Paisano Mine in the Christmas Mountains north of Big Bend National Park in Brewster County. At yearend 1979, the company was completing an 800-foot exploratory decline to evaluate further indicated reserves southeast of the company's present mining sites. Current production is from both open-cut and underground operations.

Gem Stones.—Dealers and hobbyists collected rock and mineral specimens valued at an estimated $170,000 each year in 1978-79. Included among the minerals and rocks collected were agate, calcite, cinnabar, fossiliferous limestone, fluorite, jasper, opal, petrified wood, quartz, and topaz.

Graphite.—Southwestern Graphite Co., a division of Joseph Dixon Crucible Co., closed the Nation's only graphite mine in November 1979. Unfavorable economic conditions brought about by reduced availability of graphite ore and additional government regulations were cited by the company as reasons for the closing. The company will import graphite and continue operations at the Burnet County site. Closing the mining operation reduced the work force by about 50%.

Gypsum.—Eight companies mined gypsum in Fisher, Gillespie, Hardeman, Hudspeth, Kimball, Nolan, and Stonewall Counties. In late 1978, Arlon Industries began shipping gypsum from the company's newly opened Kimball County quarry about 26 miles east of Junction. Tight supply of wallboard and other gypsum-based products in 1978-79 contributed to price increases in both crude and gypsum-based products.

In late 1979, United States Gypsum Co. began a multimillion dollar expansion program at the company's wallboard plant and gypsum mining operation near Sweetwater in Nolan County. The expansion project is scheduled for completion by early 1981.

The principal use of Texas gypsum was in manufacturing building products such as wallboard. Some gypsum was also used as a retarder in portland cement, as a filler, and as a soil conditioner.

Lime.—Eleven companies in 10 counties prepared lime in 1978-79. Comal, Johnson, and Travis Counties accounted for about 50% of the total State production.

In late 1978, a modernization and expansion program at United States Gypsum Co.'s New Braunfels plant included conversion to coal as the primary fuel.

Texas Lime Co., a subsidiary of Rangaire Corp., completed installation of a new quicklime kiln, dryer, and separation and storage facilities near Cleburne in 1979. The new coal-fired rotary kiln, with a rated daily capacity of 500 short tons of quicklime, brings the capacity of Rangaire's two Cleburne area lime plants to over 1,200 short tons per day.

In early 1979, Southern Industries Corp., Mobile, Ala., acquired Round Rock Lime Co. from A.A. Capital Corp., a subsidiary of American Airlines, for about $4.5 million. Round Rock Lime Co.'s hydrate and quicklime facility is near Blum, about 40 miles northwest of Waco. Southern Industries also operated lime plants near Morgan City, La., and Birmingham, Ala.

Table 7.—Texas: Lime sold or used by producers, by use

Use	1977		1978		1979	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Soil stabilization	509,600	$14,981	438,528	$15,291	476,925	$18,832
Water purification	221,700	7,113	133,607	4,328	231,074	9,124
Paper and pulp	89,510	2,871	128,097	4,149	153,736	6,070
Aluminum and bauxite	126,600	4,059	121,665	3,941	134,772	5,322
Steel, electric	154,400	4,951	112,403	3,641	118,252	4,669
Sewage treatment	18,230	585	28,421	921	34,101	1,346
Oil well drilling	15,410	494	19,012	616	17,195	679
Mason's lime	15,230	448	18,759	448	15,418	609
Petroleum refining	6,481	208	6,390	207	5,983	236
Other uses[1]	454,900	14,255	401,313	15,347	319,942	12,633
Total[2]	1,612,060	49,965	1,408,200	48,882	1,507,400	59,520

[1] Includes acid mine water, agriculture (1977), alkalies (1977), chrome, copper ore concentration (1977 and 1979), food and food byproducts, glass (1977 and 1979), insecticides (1977-78), magnesium, other construction lime, other metallurgy, paint tanning, wire drawing (1977 and 1979), and other chemical and industrial uses.

[2] Data may not add to totals shown because of independent rounding.

Perlite (Expanded).—Seven companies, operating plants in Bexar, Comal, Dallas, Harris, and Nolan Counties, processed imported perlite. Texas perlite mines have been inactive since 1972.

Salt.—Nine companies produced salt in brine from wells completed in salt deposits in Brazoria, Chambers, Duval, Fort Bend, Harris, Jefferson, Matagorda, Van Zandt, and Yoakum Counties. Two of the companies also produced rock salt from underground mines in Harris and Van Zandt Counties. Texas again ranked second in salt production, accounting for one of every four tons of the Nation's total output.

In January 1978, PPG Industries began a phaseout of the soda-ash, chlorine, and caustic-soda operations at the company's Corpus Christi chemical complex. This action reduced substantially the brine requirements of this plant, thus lowering the salt production of the company's solution mines on the Palangana salt dome about 40 miles west of Corpus Christi.

Sand and Gravel.—High-level construction activity, that began in 1977, was chiefly responsible for a modest increase in the output of sand and gravel in the past 2 years. Ranking third among the States in 1978-79, Texas was one of the leading producers of construction sand and gravel. Sand and gravel production (tables 8-9) was obtained from over 200 pits in 90 counties; however, 5 counties (Colorado, Dallas, Harris, Tarrant, and Victoria) accounted for over 50% of the State's total output.

The leading producer of sand and gravel in Texas continued to be Gifford-Hill & Co. in 1979; the State's other leading producers were Lone Star Industries, Thorstenburg Materials Corp., and the Fordyce Co.

Shortage of rail cars and trucks to move sand and gravel from pits and plants to market was a periodic problem in several areas of the State in 1978-79. Transportation problems were most persistent in the Colorado County area that furnished a significant part of the total sand and gravel supply to Houston and vicinity. The especially strong Houston market received sand and gravel shipments by rail from distances exceeding 300 miles.

Dresser Industries, Texas Mining Co., Pennsylvania Glass Sand Corp., and Wedron Silica Sand Co. continued to be the principal producers of industrial sand. In late 1979, Martin Marietta Corp. acquired the Wedron Silica Sand Co.'s industrial sand pit and plant in Somervell County from Twentieth Century-Fox Film Corp.

Table 8.—Texas: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	31,531	$73,869	$2.34	30,949	$81,554	$2.64	31,399	$97,655	$3.11
Plaster and gunite sands	NA	NA	NA	362	1,037	2.86	386	1,466	3.80
Concrete products	5,991	14,898	2.49	4,921	12,316	2.50	1,424	4,546	3.19
Asphaltic concrete	5,733	12,685	2.21	6,449	16,099	2.50	5,293	12,433	2.35
Roadbase and coverings	4,636	9,264	2.00	6,471	13,784	2.13	6,012	13,875	2.31
Fill	5,771	7,861	1.36	6,048	8,353	1.38	5,860	9,057	1.55
Snow and ice control	NA	NA	NA	W	W	2.33	W	W	5.39
Railroad ballast	W	W	1.75	211	326	1.55	74	183	2.49
Other uses	236	493	2.09	232	837	3.57	445	1,740	3.91
Total[1] or average	53,898	119,069	2.21	55,644	134,305	2.41	50,893	140,955	2.77

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."
[1] Data may not add to totals shown because of independent rounding.

Table 9.—Texas: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Vaue per ton
Construction:									
Sand	29,236	$57,285	$1.96	31,316	$67,289	$2.15	28,757	$71,594	$2.49
Gravel	24,662	61,784	2.51	24,328	67,016	2.75	22,137	69,360	3.13
Total[1] or average	53,898	119,069	2.21	55,644	134,305	2.41	50,893	140,955	2.77
Industrial:									
Sand	1,582	14,274	9.02	W	W	11.98	1,953	26,121	13.38
Gravel	16	77	4.95	W	W	4.34	--	--	--
Total[1] or average	1,597	14,351	8.98	1,281	15,294	11.94	1,953	26,121	13.38
Grand total or average	55,495	133,420	2.40	56,925	149,599	2.63	52,846	167,076	3.16

W Withheld to avoid disclosing company proprietary data; included in "Total."
[1] Data may not add to totals shown because of independent rounding.

Sodium Sulfate (Natural).—Ozark-Mahoning Co. continued to extract sodium sulfate from alkali-lake bed brines in Gaines and Terry Counties. Sodium sulfate was used to manufacture detergents, glass, kraft paper, and other products.

Stone.—Texas continued to lead the Nation in crushed stone production. A modest increase in 1979 over 1978's record output resulted from a sustained high-level construction activity in the State, especially in Houston and other metropolitan areas. Because an exceptionally strong aggregate market existed in Houston, Beaumont, and other upper gulf coastal cities during the past 2 years, some barge shipments of crushed stone were made into this market from as far away as Kentucky.

In 1978, Gifford-Hill & Co., Inc., entered the crushed stone business in central Texas when the company acquired the Ogden limestone quarry in Comal County from Servtex, Inc. The Ogden quarry has been one of the State's top 20 producers of crushed limestone for a number of years. About one-half of the State's total crushed stone output was from 20 large quarries, although production was obtained from several hundred sites within the State. The leading crushed stone producers were Texas Crushed Stone Co., Parker Bros., McDonough Bros., Inc., and Gifford-Hill & Co., Inc. The leading counties in output of crushed stone continued to be Bexar, Comal, Ellis, Williamson, and Wise, About 95% of the total crushed stone production was limestone; the other 5% consisted of granite, marble, marl, sandstone, shell, and traprock.

Dimension stone, consisting of granite, limestone, and marble, was obtained from quarries in Burnet, Gillespie, Jones, Llano, Mason, and Williamson Counties. Dimension stone was prepared as rough and cut stone for use in buildings, facings, foundations, retaining walls, and for monuments and gravestones.

Table 10.—Texas: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	371	564	870	1,267	310	620
Poultry grit and mineral food	151	528	144	750	154	971
Concrete aggregate	r8,535	r18,668	13,135	33,958	11,433	36,892
Bituminous aggregate	4,135	13,893	3,938	18,289	5,525	26,062
Macadam aggregate	W	W	W	W	218	619
Dense-graded roadbase stone	r27,171	r40,407	28,138	46,571	30,855	58,890
Surface treatment aggregate	4,309	10,291	3,076	9,601	3,190	10,791
Other construction aggregate and roadstone	4,313	7,958	3,106	5,958	4,949	11,689
Riprap and jetty stone	547	1,249	430	1,256	326	1.036
Railroad ballast	1,147	2,307	899	2,501	905	2,991
Filter stone	97	160	58	140	649	1,790
Manufactured fine aggregate (stone sand)	1,146	2,535	1,286	3,189	1,817	4,577
Terrazzo and exposed aggregate	107	1,308	89	1,153	97	1,224
Cement manufacture	8,866	12,296	9,521	13,565	9,984	16,609
Lime manufacture	r2,070	r4,136	2,727	5,778	2,101	4,814
Flux stone	825	1,581	411	733	987	2,080
Other fillers or extenders	168	877	495	4,188	358	4,699
Roofing granules	148	785	109	398	76	279
Building products	--	--	12	25	W	W
Sugar refining	W	W	11	25	24	71
Waste material	274	321	274	321	19	23
Other uses[2]	r1,065	r2,919	365	1,204	636	2,021
Total[3]	65,446	122,784	69,095	150,868	74,612	188,746

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, marble, marl, sandstone, shell, traprock, and other stone (1978).

[2] Includes stone used in chemical stone (1977 and 1979), refractory stone (1978), asphalt filler, mine dusting (1977), whiting or whiting substitute, chemicals (1977), sulfur dioxide (1978-79), unspecified uses, and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Sulfur.—Duval Corp. mined Frasch sulfur in Culberson County; Farmland Industries in Pecos County; Jefferson Lake Sulfur Co. in Wharton County; and Texasgulf, Inc. in Liberty, Pecos, and Wharton Counties.

In late 1979, Duval Corp. announced plans to open a Frasch mine on the Phillips Ranch in Culberson County, about 5 miles west-southwest of the company's large Orla operation. The new mine is to go onstream in the latter part of 1980.

Recovered sulfur was extracted from natural gas and crude oil at over 50 operations in 30 counties. Harris, Jefferson, and Van Zandt Counties contributed over one-half of the recovered sulfur.

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Talc and Soapstone.—Five companies mined talc from quarries in Culberson and Hudspeth Counties. Talc and soapstone were used in manufacturing ceramic products, roofing materials, paint, insecticide carriers, and other products.

In late 1979, English China Clay's Ltd. acquired Southern Clay Products, Inc.'s talc operations.

Vermiculite.—In April 1979, Volite, Inc., closed the company's vermiculite mine and exfoliation plant in Llano County. Crude vermiculite continued to be imported and exfoliated in plants in Bexar, Dallas, and Harris Counties in 1978-79. Exfoliated vermiculite was used as concrete and plaster aggregate, loose-fill and block insulation, soil conditioner, and fireproofing.

METALS

Although small quantities of gold, lead, silver, and zinc were recovered from a small mining operation in the Trans-Pecos, Tex., area in 1978, iron and magnesium continued to be the important indigenous metallic nonfuel minerals mined in Texas. Aluminum, antimony, cadmium, copper, gold, iron, lead, silver, tin, tungsten, and zinc were also recovered from imported ores and concentrates at smelters, refineries, and reduction plants in the State. Metal scrap and other materials were processed for reuse at a number of secondary-metal recovery facilities.

Aluminum.—Imported bauxite was processed at alumina refineries of Reynolds Metal Co. near Corpus Christi, and at Aluminum Co. of America (Alcoa) near Point Comfort.

At yearend 1979, over 50% of the idle metal productive capacity at Alcoa's Point Comfort smelter and Reynolds Metal Co.'s Corpus Christi reduction works had been brought back online. Of the seven potlines at the Point Comfort plant, five were shut down in December 1974, a sixth in September 1975, and the final unit in May 1978. In early 1979, Alcoa restarted three of the potlines and by yearend 1979, had four of the seven potlines back in production.

In March 1979, Reynolds Metals Co. restarted one of the two metal-producing units at its Corpus Christi smelter that had been closed since 1975. At yearend 1979, the second potline was being prepared for a January 1980 startup. The Point Comfort and Corpus Christi smelters were closed because of the sharp increase in the price of natural gas and weak metal market.

A new smelting process developed by Alcoa continued a shakedown evaluation at the Anderson County works. The new reduction process requires less electricity than the conventional smelting method. At yearend 1979, all eight potlines at Alcoa's large Rockdale smelter were in operation. Operations at the Rockdale smelter are not as sensitive to the price of natural gas because electric power used at this plant is generated by burning lignite.

Antimony.—In November 1978, Anzon American, Inc., a British-owned firm, reopened the primary antimony smelter in Laredo. Anzon purchased the smelter for over $3 million from NL Industries, Inc., who had closed the facility in late 1977.

In 1979, Anzon announced plans to expand and modernize the smelter. To be completed in about 2 years, the expansion will increase capacity of the smelter about fourfold. Ore treated at the Laredo smelter is imported from the Republic of Mexico.

In 1979, ASARCO Incorporated completed construction of a new antimony metal plant at the company's El Paso metallurgical complex. The facility employs new technology to recover antimony from tetrahedrite copper concentrates. At yearend, startup problems continued at the facility.

Cadmium.—Cadmium was recovered as a byproduct at the Asarco electrolytic zinc plant in Corpus Christi.

Copper.—Imported copper ores and concentrates were smelted at Asarco's metallurgical works in El Paso. Refined copper was produced at Asarco's Amarillo copper refinery and by Phelps Dodge's El Paso refinery.

In 1979, work was begun to modify the Amarillo continuous-cast rod mill to increase the output by about 50%. The project is to be completed by mid-1980.

Asarco's El Paso copper smelter operated at about 75% of its effective capacity in 1979. Copper production at the smelter was curtailed periodically to comply with governmental air-quality standards during certain unfavorable atmospheric conditions.

At yearend 1979, Asarco was preparing to convert the reverberatory copper smelting furnaces at the El Paso smelter to coal firing to cut fuel cost and reduce dependence on natural gas and fuel oil. Estimated to cost about $2.8 million, the project is to be completed by the 1980-81 heating season, when natural gas for industrial use could again be curtailed.

Iron Ore.—Brown iron ore (limonite and siderite), mined from open pits in Cass.

Cherokee, Henderson, and Morris Counties, was used in producing cement, pig iron, as an animal-feed supplement, and for other uses.

In March 1978, Tex-Iron, Inc., opened a new mine in Henderson County to replace a mine in Nacogdoches County that was closed in June 1977. Mathis and Mathis continued to mine iron ore from open pits in Cass County, and Hudson Bros. operated a small mine in Cherokee County.

In 1979, Lone Star Steel Co., the State's largest producer of iron ore, completed a $13.5 million expansion program at the E. B. Germany works in Morris County. The project included the production facilities for large-diameter mechanical tubing, a 70-oven coke battery, and an upgrading of the iron ore sintering operation.

Lone Star Steel Co. continued to mine iron ore in Cass and Morris Counties. Production was down in 1978 because the iron ore sintering plant was being rebuilt. All of the production was converted to iron and steel at the company's integrated steel mill near Daingerfield.

Lead.—Primary lead continued to be recovered at Asarco's large metallurgical smelter in El Paso. A major modernization program was completed in mid-1979 with the startup of a new lead ore roasting furnace and sintering plant. The new plant provides for full recovery of sulfur oxide and particulate emissions.

Magnesium.—Magnesium again was the leading value contributor of the metallic minerals produced in Texas. Two companies recovered magnesium chloride from seawater in Brazoria County and from subsurface brine in Borden County for producing magnesium compounds and magnesium metal.

In 1979, Dow Chemical made modifications at the company's Freeport operation that are expected to increase significantly the productive capacity of the plant. Dow also was considering building a pilot plant to test a new electrolytic process that could be 50% more energy efficient than the process used at the Freeport plant. American Magnesium Corp. was making modifications to increase the productive capacity of its Snyder plant.

Manganese.—Tenn-Tex Alloy Corp. produced silico-manganese and ferromanganese at the company's plant in Houston. Feedstocks were imported.

Molybdenum.—In Culberson County, Draco Mines conducted an exploratory drilling program at the Cave Peak molybdenum prospect about 30 miles north of Van Horn. Molybdenum was also Draco's exploration target near the abandoned Bird lead-silver mine in Brewster County.

At yearend 1979, the company had completed the initial exploration programs at both prospects and was evaluating the results before deciding whether to conduct additional exploration, proceed with mining plans, or abandon the projects.

Silver and Gold.—Asarco continued to recover these precious metals at the company's Amarillo refining facilities. In Hudspeth County, Bonanza Mining Ventures, Ltd., failed to find sufficient reserves to reopen the Bonanza Mine in the Quitman Mountains. For a short period, a small flotation mill was operated, using ore from an exploration adit. In December 1978, the company ceased operation and sold its interest in the property after recovering small quantities of gold, lead, silver, and zinc.

Silver was the objective of a large-scale drilling program Gold Field Mining Corp. conducted in Presidio County near the abandoned Presidio Mine. Gold Field Mining is an American subsidiary of Consolidated Gold Fields, Ltd., a British company. The Presidio Mine, the State's largest silver and gold producer, yielded over 30 million ounces of silver and about 8,000 ounces of gold before it was closed in 1942. At yearend 1979, Gold Field Mining had applied for the necessary State permit to open a mine adjacent to the old Presidio Mine workings.

Tin.—Gulf Chemical & Metallurgical Corp. continued to recover tin at the company's Texas City smelter. In late 1978, a newly installed furnace allowed the refining of tin from a wider range of feeds. The high-speed tilting rotary furnace enables the company to conduct tin smelting and volatilization operations in one vessel.

In 1979, D & B Development Co., El Paso, completed a drilling and trenching exploration program near the old tin mine in the North Franklin Mountains in El Paso County. Results of the exploration program were not made public.

Zinc.—Asarco shut down about 50% of the Corpus Christi zinc-refining capacity for about 4 months in mid-1978 because of continued softness in the market. In 1979, a $42 million modernization program was begun at the refinery. When completed in late 1981, the plant will be able to process a wider range of concentrates, reduce production costs, and increase refined zinc output by about 25%.

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[1] State mineral specialist, Bureau of Mines, Denver, Colo.

[2] Research geologist, Bureau of Economic Geology, The University of Texas, Austin, Tex.

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Table 11.—Texas: Primary smelters, refineries, and reduction plants

Product, company, and plant	Location (county)	Material treated
Aluminum:		
Aluminum Co. of America:		
Point Comfort (alumina)	Calhoun	Bauxite.
Point Comfort (reduction)	do.	Alumina.
Rockdale (reduction)	Milam	Do.
Anderson County (reduction)	Anderson	Do.
Reynolds Metals Co.:		
San Patricio (reduction)	San Patricio	Do.
Sherwin plant (alumina)	do.	Bauxite.
Antimony:		
ASARCO Incorporated:		
El Paso smelter	El Paso	Ore.
Anzon American, Inc.:		
Laredo smelter	Webb	Do.
Cadmium:		
ASARCO Incorporated:		
Electrolytic	Nueces	Do.
Copper:		
ASARCO Incorporated:		
Amarillo refinery	Potter	Blister and anode.
El Paso smelter	El Paso	Ore and concentrates.
Phelps Dodge Refining Corp.:		
Nichols refinery	do.	Blister and anode.
Iron:		
Armco Steel Corp.:		
Houston plant	Harris	Ore and scrap.
Lone Star Steel Co.:		
Daingerfield plant	Morris	Do.
United States Steel Corp.:		
Baytown plant	Chambers	Do.
Lead:		
ASARCO Incorporated:		
El Paso smelter	El Paso	Ore and concentrates.
Magnesium:		
Dow Chemical USA:		
Freeport plants, electrolytic	Brazoria	Seawater.
American Magnesium Co.:		
Snyder plant, electrolytic	Scurry	Brine.
Manganese:		
Tenn-Tex Alloy Corp	Harris	Ore.
Sodium:		
Ethyl Corp	do.	Salt.
Tin:		
Gulf Chemical & Metallurgical Corp.:		
Texas City smelter	Galveston	Ore.
Zinc:		
ASARCO Incorporated:		
Corpus Christi electrolytic	Nueces	Ore and concentrates.
El Paso fuming plant	El Paso	Dusts and residues.

Table 12.—Texas: Secondary metal recovery plants

County and company	Material	Product
Austin:		
Schinlder Bros. Steel Co	Steel scrap	Reinforced steel bars.
Bexar:		
Newell Salvage Co. of San Antonio	Scrap metal	Smelted and refined scrap metals.
Brazoria:		
Texas Reduction Corp	Aluminum scrap	Alloyed aluminum ingot.
Collin:		
Electro Extraction, Inc	Aluminum and copper scrap	Aluminum ingots, copper bars.
Gould, Inc	Lead scrap	Battery lead oxide, pig lead.
Dallas:		
ABASCO, Inc	Aluminum scrap	Aluminum ingots, dioxidizing bars and shot.
American Smelting and Refining Works	Lead and zinc scrap	Lead and zinc ingots, pigs, and alloys.
Dixie Metals Co	Lead scrap	Lead pigs, alloys, chemicals.
Laclede Steel Corp	Steel scrap	Reinforcing steel.
Murdock Lead Co., a division of RSR Corp.	Lead scrap	Lead shot, solders, lead pipe.
NL Industries, Inc	Battery plates	Lead products.
Okon's Iron & Metal Co	Solder and lead scrap	Lead pigs and ingots.
Southern Lead Co., a division of RST Corp.	Battery plates	Lead pigs, alloys.
El Paso:		
Border Steel Mills, Inc	Steel scrap	Reinforcing bars, bars shapes, steel grinding balls.
Proler International Corp	do	Precipitation iron.
SEC Corp	Nickel-copper waste solution	Nickel.

Table 12.—Texas: Secondary metal recovery plants —Continued

County and company	Material	Product
Ellis:		
Chaparral Steel Co	Steel scrap	Steel reinforcing bars and shapes.
Industrial Metals Co	Scrap metal	Metal shapes and ingots.
Galveston:		
Gulf Chemical & Metallurgical Corp	Various metal scrap	Tin, tungsten, nickel.
Gregg:		
Marathon-LeTourneau Co	Steel scrap	Steel castings and shapes.
Southwest Steel Castings Co	do	Steel castings.
Guadalupe:		
Structural Metals Inc	do	Structural steel reinforcing bars.
Harris:		
A & B Metal Manufacturing Co., Inc	Scrap metal	Tungsten carbide.
Federated Metals Corp	Various metals	Lead ingot, solder, copper tubing, bearing metals, sheet lead, lead pipe.
Gulf Reduction Corp	Aluminum, zinc scrap	Aluminum, zinc ingots and alloys.
Houston Lead Co	Lead scrap	Lead pigs, ingots, alloys.
Lead Products Co., Inc	do	Do.
Newell Metals, Inc	Zinc scrap	Zinc dust.
Proler International Corp	Various metals	Zinc slab, aluminum alloys, precipitation iron.
Redgate, Virgil, Co	do	Recovery of gold, silver platinum, rhodium, copper, nickel, cadmium, aluminum.
Jefferson:		
Georgetown Texas Steel Corp	Steel scrap	Steel rods and shapes.
Laclede Steel Corp	do	Reinforcing steel.
Leon:		
Nucor Steel Co	do	Steel rods and shapes.
Smith:		
Bloch Metals, Inc	Aluminum scrap	Aluminum ingots.
Tyler Pipe Industries, Inc	Steel scrap	Pipe and pipe fittings.
Tarrant:		
National Metal and Smelting Co	Battery lead and aluminum scrap	Lead pigs, ingots, battery metal, aluminum ingots.
Texas Steel Co	Steel scrap	Carbon and alloy steel bars and shapes, reinforcing bars.

Table 13.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt (native):			
Uvalde Rock Asphalt Co	Box 531 San Antonio, TX 78206	Quarry and plant	Uvalde.
White's Mines, Inc	Box 499 San Antonio, TX 78206	do	Do.
Barite:			
Dresser Industries	Box 6504 Houston, TX 77002	Grinding plant	Cameron and Galveston.
Milwhite Co., Inc	Box 15038 Houston, TX 77020	do	Cameron and Harris.
NL Industries, Inc	Box 1675 Houston, TX 77001	do	Nueces.
Cement:			
Alpha Portland Cement Co	15 South 3d St. Easton, PA 18042	Quarry and plant	Orange.
Capitol Aggregates, Inc	Route 13, Box 412 San Antonio, TX 78209	do	Bexar.
Centex Cement Corp	4600 Republic Bank Tower Dallas, TX 75201	do	Hays and Nueces.
General Portland, Inc	2800 Republic Bank Tower Dallas, TX 75201	do	Dallas and Tarrant.
Gifford-Hill & Co., Inc	Box 520 Midlothian, TX 76065	do	Ellis.
Gulf Coast Portland Cement Co., a division of McDonough Co.	Box 262 Houston, TX 77001	do	Harris.
Ideal Cement Co., a division of Ideal Basic Industries, Inc.	420 Ideal Cement Bldg. Denver, CO 80202	do	Do.
Longhorn Cement Div., Kaiser Cement Corp.	Kaiser Center 300 Lakside Dr. Oakland, CA 94612	do	Bexar.
Lone Star Industries, Inc	Box 47327 Dallas, TX 75247	do	Harris and Nolan.
San Antonio Portland Cement Co.	Box 6925 San Antonio, TX 78209	do	Bexar.
Southwestern Portland Cement Co.	Box 392 El Paso, TX 79943	do	Ector, El Paso, Potter.
Texas Industries, Inc	Box 146 Midlothian, TX 76065	do	Ellis.

Table 13.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Cement —Continued			
Universal Atlas Cement, a division of U.S. Steel Corp.	600 Grant St. U.S. Steel Bldg. Pittsburg, PA 15230	Quarry and plant	McLennan.
Clay and shale:			
Acme Brick Co., a division of Justin Industries, Inc.	Box 425 Fort Worth, TX 76101	Pit and plant	Denton, Guadalupe, Nacogdoches, Parker, Van Zandt, Wise.
Balcones Minerals Corp	Box B Flatonia, TX 78941	do	Fayette.
Dresser Industries, Inc	601 Jefferson Houston, TX 77002	do	Angelina and Limestone.
Elgin-Butler Brick Co	Box 1947 Austin, TX 78767	do	Bastrop.
Featherlite Corp	Box 141 Ranger, TX 76470	do	Eastland.
General Portland, Inc	Box 2698 Dallas, TX 75201	do	Dallas and Limestone.
General Refractories Co	1520 Locust St. Philadelphia, PA 19102	do	Cherokee.
Gulf Coast Portland Cement Co., a division of McDonough Co.	Box 262 Houston, TX 77001	Pit	Chambers.
Henderson Clay Products Co	Box 1251 Henderson, TX 75652	Pit and plant	Rusk.
Lone Star Industries, Inc	Box 47327 Dallas, TX 75247	Pit	Fisher and Harris.
Milwhite Co., Inc	Box 15038 Houston, TX 77020	Pit and plant	Fayette and Walker.
Southern Clay Products, Inc	Box 44 Gonzales, TX 78629	do	Angelina, Cherokee, Gonzales.
Texas Clay Products, Inc	Box T Malakoff, TX 75148	do	Henderson.
Texas Industries, Inc	8100 Carpenter Freeway Dallas, TX 75247	do	Comanche, Dallas, Ellis, Fort Bend, Henderson, Marion, Van Zandt.
Fluorspar:			
D & F Minerals Co	Box 75 Terlingua, TX 79852	Mine	Brewster.
Graphite:			
Southwestern Graphite Co	Burnet, TX 78611	Mine and mill	Burnet.
Gypsum:			
Celotex Corp	1500 North Dale Mabry Tampa, FL 33607	Quarry and calcining plant.	Fisher.
Flintkote Co	400 Westchester Ave. White Plains, NY 10604	do	Nolan.
Georgia Pacific Corp	900 SW. 5th Ave. Portland, OR 97204	do	Hardeman.
National Gypsum Co	325 Delaware Ave. Buffalo, NY 14202	do	Fisher.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Nolan.
Do	do	Plant	Harris.
Iron ore:			
Lone Star Steel Co	Box 12226 Dallas, TX 75225	Mine	Cass and Morris.
Tex-Iron, Inc	Box 46 LaRue, TX 75770	do	Henderson.
Lime:			
Aluminum Co. of America	1028 Alcoa Bldg. Pittsburgh, PA 15219	Plant	Calhoun.
Armco Steel Corp	Box 1367 Houston, TX 77001	do	Harris.
Austin White Lime Co	Box 9556 Austin, TX 78766	do	Travis.
Champion International Corp	Box 872 Pasadena, TX 77501	do	Harris.
Chemical Lime Co	Box 427 Clifton, TX 76634	do	Bosque.
Holly Sugar Corp	Drawer 1778 Hereford, TX 79045	do	Deaf Smith.
McDonough Bros., Inc	Fredericksburg Rd. Route 8, Box 222 San Antonio, TX 78228	do	Bexar.
PPG Industries, Inc	Box 4026 Corpus Christi, TX 78408	do	Nueces.
Round Rock Lime Co	Box 38 Blum, TX 76627	do	Hill.
Texas Lime Co	Box 851 Cleburne, TX 70631	do	Johnson.
United States Gypsum Co	101 South Wacker Dr. Chicago, IL 60606	do	Comal.

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Table 13.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel:			
Capitol Aggregates, Inc	Route 13, Box 142 San Antonio, TX 78209	Stationary plant	Guadalupe and Travis.
Dresser Industries, Inc	Kosse, TX 76653	do	Limestone.
The Fordyce Co	Box 1981 San Antonio, TX 78206	do	Hidalgo and Victoria.
Fort Worth Sand & Gravel Co	Box 400 Arlington, TX 76010	do	Dallas, Denton, Tarrant.
Gifford-Hill & Co., Inc	Box 47127 Dallas, TX 75247	do	Brazos, Clay, Dallas, McLennan, Tarrant.
R. E. Janes Gravel Co	Box 2155 Austin, TX 78767	do	Borden, Crosby, Lubbock, Taylor.
Lone Star Industries, Inc	Box 47327 Dallas, TX 75247	do	Colorado and Denton.
Parker Bros. & Co., Inc	Box 107 Houston, TX 77001	Stationary plant and dredge.	Colorado, Harris, Victoria.
Thorstenberg Materials Corp	1435 Bank of the Southwest Houston, TX 77002	do	Do.
Shell:			
Parker Bros. & Co., Inc	5303 Navigation Bldg. Box 107 Houston, TX 77001	Dredge	Calhoun.
Sodium (metallic):			
Ethyl Corp	Box 472 Pasadena, TX 77502	Plant	Harris.
Sodium sulfate (natural):			
Ozark-Mahoning Co	1870 South Boulder Tulsa, OK 74119	do	Gaines and Terry.
Stone:			
Barrett Industries	2718 SW. Military Dr. San Antonio, TX 78221	Quarry	Bexar.
General Portland, Inc	2800 Republic Bank Tower Dallas, TX 75201	do	Dallas, Tarrant, Wise.
Gifford-Hill & Co., Inc	Box 47127 Dallas, TX 75247	do	Comal, Ellis, Wise.
Lone Star Industries, Inc	Box 47327 Dallas, TX 75247	do	Burnet, Nolan, Wise.
McDonough Bros., Inc	Route 8, Box 222 San Antonio, TX 78228	do	Bexar.
Parker Bros. & Co., Inc	Box 107 Houston, TX 77001	do	Comal.
Texas Crushed Stone Co	Box 9345 Austin, TX 78717	do	Llano and Williamson.
Texas Industries, Inc	Box 146 Midlothian, TX 76065	do	Ellis and Wise.
White's Mines, Inc	Box 499 San Antonio, TX 78206	do	Brown, Taylor, Uvalde.
Sulfur (byproduct):			
Amoco Production Co	Box 591 Tulsa, OK 74102	Secondary recovery	Andrews, Ector, Hockley, Van Zandt, Wood.
Cities Service Oil Co	Box 300 Tulsa, OK 74102	do	Cochran, Dawson, Gaines, Van Zandt.
Getty Oil Co	Box 8 Scroggins, TX 75480	do	Franklin and Freestone.
Gulf Oil Co	Box 701 Port Arthur, TX 77640	do	Jefferson.
Phillips Petroleum Co	Bartlesville, OK 74003	do	Brazoria, Crane, Ector, Hutchinson.
Shell Oil Co	Box 2099 Houston, TX 77001	do	Cass, Harris, Karnes.
Warren Petroleum Corp	Box 1589 Tulsa, OK 74101	do	Crane, Hopkins, Karnes.
Sulfur (native):			
Duval Corp	1906 First City National Bank Houston, TX 77002	Frasch mine	Culberson.
Farmland Industries, Inc	Box 850 Fort Stockton, TX 79735	do	Pecos.
Jefferson Lake Sulfur Co	Box 1185 Houston, TX 77001	do	Fort Bend.
Texasgulf, Inc	200 Park Ave. New York, NY 10017	do	Fort Bend, Jefferson, Liberty, Pecos, Wharton.
Talc:			
Pioneer Talc Co., Inc	Chatsworth, GA 30705	Mine and plant	Hudspeth.
Southern Clay Products, Inc	Box 44 Gonzales, TX 78629	Mine	Do.
United Sierra, a division of Cyprus Mines Corp.	Box 1201 Trenton, NJ 08606	do	Do.
Westex Talc Co	Box 15038 Houston, TX 77020	Mine and plant	Culberson and Hudspeth.

Table 13.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Vermiculite:			
W. R. Grace & Co	2651 Manila Rd. Dallas, TX 75200	Exfoliating plant	Bexar and Dallas.
Vermiculite Products, Inc	Box 7327 Houston, TX 77008	do	Harris.
Volite, Inc	Box 122 Llano, TX 78643	Mine and plant	Llano.

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The Mineral Industry of Utah

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Utah Geological and Mineral Survey, for collecting information on all nonfuel minerals.

By Lorraine B. Burgin[1]

The value of nonfuel mineral production in Utah continued to rise throughout the 1978-79 biennium. In 1978, the value of nonfuel materials was 552.6 million; and in 1979, the value climbed to $753.4 million reflecting higher prices in almost all minerals. Although the amount of production increased in many commodities, the rise was not as extensive as the increase in value.

Metals, mainly from Kennecott Copper Corp., Utah Copper Div., accounted for over three-fourths of Utah's nonfuel minerals production in both years; and copper accounted for about one-half of that total value. Recovered principally as byproducts of copper production, gold, molybdenum, and silver contributed nearly one-fifth of the value of nonfuel mineral output in Utah in 1978, and almost one-fourth of that value in 1979. Beryllium, copper, gold, and molybdenum increased in amount and value in 1978-79. Lead and zinc production declined dramatically when two mines were closed in 1978. Silver, recovered as an important byproduct of those base metal operations, dropped in production; however, the total value of the commodity enjoyed a marked increase in 1979 because of the soaring price of silver.

In 1979, Utah ranked first in the Nation in value of gold and beryllium produced, second in value of copper, and third in value of molybdenum. As a lead-producing State, Utah, in 1979, dropped from 4th to 12th place; and as a zinc-producing State, the drop was from 10th place to 19th, last place among the States. The price of zinc had maintained a steady low level and did not serve as a stimulus for increasing production.

In the nonmetals group, leading commodities in both years included cement, potash, salt, and sand and gravel. Increases were noted in value of cement, clay, gypsum, phosphate, potash, salt, and stone.

Legislation and Government Programs.—During the biennium, the mining industry became increasingly concerned over the land status situation, particularly when studies by the Forest Service, National Park Service, and Bureau of Land Management (BLM) resulted in proposals for additional wilderness areas and subsequent withdrawal of these areas from prospecting, exploration, and mining. By 1978, the Forest Service Roadless Area Review and Evaluation (RARE II) program had inventoried nearly 3 million acres. In that year, areas in Utah proposed by the Forest Service for wilderness designation included 455,000 new acres of wilderness in addition to the 323,000 acres of wilderness and primitive areas proposed under earlier legislation. An additional 149,000 acres were proposed for further study, and 2.1 million acres were proposed for release from further wilderness review and returned to multiple-management. The National Park Service, in 1978, completed its recommendations to Congress on 1.2 million acres in all national parks and monuments in Utah, except Glen Canyon National Recreation Area.

Under the Federal Land Policy and Management Act of 1976, BLM was to review all roadless areas of 5,000 acres and more, and all BLM-administered lands of whatever size to determine which areas should receive protective wilderness designation. The BLM completed the first phase of their review in Utah in 1978 by designating 11 natural and primitive areas as "instant study areas." The 11 areas to be reviewed for possible wilderness status were (1) Book Cliffs Natural Area about 30 miles north of Moab, (2) Link Flat Natural Area south of I-70 and west of Green River, (3) Park Canyon Primitive Area south of Canyonlands National Park, (4) Grand Gulch Primitive Area southeast of Natural Bridges National Monument, (5) Phipps Death Hollow Natural Area in the Escalante River Basin, (6) The Gulch Natural Area also in the Escalante Basin, (7) North Escalante Canyon Natural Area, (8) Escalante Canyon Natural Area, (9) Devil's Garden Natural Area just south of Escalante, (10) Paria Canyon Primitive Area between Kanab and Glen Canyon on the Arizona border, and (11) Joshua Tree Natural Area in southwestern Utah. The BLM Utah: Final, Initial Wilderness Inventory report and map was published in August 1979. BLM is expected to make its recommendations by July 1980. The agency still has a number of years in which to complete submission of reports and recommendations on the balance of its roadless areas, totaling 11 to 12 million acres, including the 11 natural and primitive areas.

Further concern over the restriction in the use of Government land developed when western Utah and eastern Nevada were proposed as sites for the MX missile system. Mining industry leaders questioned the location of such a project near areas where mining operations might be interrupted or curtailed.

In September of 1978, the U.S. Environmental Protection Agency (EPA) held a hearing to discuss new standards for sulfur dioxide emissions at the new Noranda process smelter of the Utah Copper Div. of Kennecott Copper Corp. The EPA limitation on sulfur dioxide emissions from the new smelter had been 6,900 pounds per hour, but in August, the agency promulgated regulations that would lower the allowable emissions to 3,700 pounds per hour. The company received general support from the public, and the Utah Air Conservation Commission Committee took the position that EPA should not impose new regulations until emissions had been thoroughly monitored and emission limitations established on a scientifically sound basis. In 1979, Kennecott Minerals Co. contended its operations were in compliance with ambient air quality standards for sulfur dioxide, achieved by constant engineering controls at processing plants and by curtailment of smelting operations to reduce emissions under certain weather conditions. Some governmental agencies specified that ambient air standards must be met by engineering controls only. The company sought relief through administrative and judicial review processes.

United States Steel Corp. and EPA attempted to negotiate an agreement in principle on emission controls at the firm's Geneva Works. The company maintained that the more than $100 million pollution control program requested by EPA would be too costly. By yearend, agreement between the two entities had not been achieved.

The Bureau of Mines, in fiscal years 1978 and 1979, granted several research contracts to various universities and private institutions in the State. Studies were related to haul-road dust emissions, probabilistic modeling of tailings designs, noise control of underground load-haul-dump machines, analysis and restoration of ground water quality after in situ uranium leaching, and roof bolt behavior. In 1978-79, the U.S. Department of Energy funded the University of Utah for an investigation of the energy requirements of new smelting and refining processes in copper production.

In 1978, the University of Utah was designated, by the Secretary of the Interior, as one of 31 universities where a State Mining and Mineral Resources and Research Institute would be established, pursuant to Title III of Public Law 95-87. The institute will establish training programs in mining and minerals extraction and provide scholarships and fellowships. It will receive annual allotments of $110,000 through 1984, plus $160,000 for scholarships and fellowships for a 3-year period.

The University of Utah signed an agreement to purchase the U.S. Bureau of Mines five-building, 13-acre complex on its campus. The facilities will provide research space for the College of Mines and Minerals Industries and College of Engineering. Transfer of the property, to be purchased for $978,000, will be completed when the new $10 million Bureau of Mines building is completed adjacent to the University of Utah Research Park.

Table 1.—Nonfuel mineral production in Utah[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Carbon dioxide, natural thousand cubic feet	W	W	W	W	W	W
Clays thousand short tons	[2]244	[2]$713	265	$913	355	$1,246
Copper (recoverable content of ores, etc.) metric tons	176,111	259,357	186,330	273,175	193,082	396,003
Gem stones	NA	100	NA	75	NA	75
Gold (recoverable content of ores, etc.) troy ounces	210,501	31,219	235,929	45,664	260,916	80,232
Gypsum thousand short tons	324	2,510	316	2,777	772	6,552
Iron ore (usable) thousand long tons, gross weight	1,932	19,780	1,961	21,224	1,618	19,391
Lead (recoverable content of ores, etc.) metric tons	9,749	6,598	2,541	1,888	W	W
Lime thousand short tons	209	8,274	225	7,196	198	8,250
Pumice do	W	W	28	270	28	280
Salt do	843	10,831	956	13,532	1,204	14,723
Sand and gravel[3] do	11,895	18,662	12,530	21,840	10,363	18,621
Silver (recoverable content of ores, etc.) thousand troy ounces	3,283	15,169	2,885	15,579	2,454	27,216
Stone:						
Crushed thousand short tons	2,765	7,072	2,817	9,716	3,424	11,059
Dimension do	6	238	7	264	5	216
Tungsten thousand pounds	27	219	11	80	W	W
Zinc (recoverable content of ores, etc.) metric tons	16,111	12,218	3,509	2,398	W	W
Combined value of asphalt, beryllium concentrate, cement, clays (kaolin and fuller's earth, 1977), magnesium compounds, molybdenum, phosphate rock, potassium salts, sand and gravel (industrial), sodium sulfate, vanadium, and values indicated by symbol W	XX	104,260	XX	136,041	XX	169,520
Total	XX	497,220	XX	552,632	XX	753,384

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes kaolin and fuller's earth; value included in "Combined value" figure.

[3] Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Utah, by county

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Beaver	$30	$30	Sand and gravel.
Box Elder	1,923	1,817	Stone, sand and gravel, lime, salt, tungsten.
Cache	1,114	W	Sand and gravel, stone.
Carbon	W	W	Carbon dioxide, sand and gravel.
Daggett	--	--	
Davis	W	W	Sand and gravel, stone, tungsten.
Duchesne	W	438	Sand and gravel, stone.
Emery	W	W	Sand and gravel, vanadium.
Garfield	W	W	Vanadium, sand and gravel.
Grand	[r]5,949	7,985	Potassium salts, vanadium, salt.
Iron	W	W	Iron ore, sand and gravel.
Juab	W	W	Silver, gold, copper, gypsum, stone.
Kane	396	W	Sand and gravel, stone.
Millard	W	W	Pumice, gypsum, sand and gravel, beryllium.
Morgan	W	W	Cement, stone, sand and gravel.
Piute	W	--	
Rich	W	--	
Salt Lake	344,518	403,007	Copper, molybdenum, gold, cement, silver, sand and gravel, salt, stone, lime, clays, lead, zinc.
San Juan	W	W	Vanadium.
Sanpete	2,311	2,339	Sand and gravel, gypsum, clays.
Sevier	2,308	W	Gypsum, salt, clays, sand and gravel.
Summit	12,834	W	Zinc, clays, lead, silver, stone, gold, copper.
Tooele	17,362	17,972	Lime, salt, potassium salts, stone, sand and gravel, tungsten, magnesium compounds, clays.
Uintah	17,049	W	Phosphate rock, asphalt, sand and gravel, stone.
Utah	18,755	17,095	Stone, gold, silver, sand and gravel, zinc, lead, copper, clays.
Wasatch	258	W	Stone, sand and gravel.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Utah, by county —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Washington	W	W	Sand and gravel, stone.
Wayne	$40	$40	Sand and gravel.
Weber	18,232	22,513	Potassium salts, salt, asphalt, sand and gravel, sodium sulfate, magnesium compounds, clays, stone.
Undistributed[1]	54,139	79,389	
Total[2]	497,220	552,632	

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1] Includes sand and gravel that cannot be assigned to specific counties, gem stones, and values indicated by symbol W.
[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Utah business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	529.0	544.0	584.0	+7.4
Unemployment	do	28.0	21.0	25.0	+19.0
Employment (nonagricultural):					
Mining[1]	do	14.9	15.9	17.8	+11.9
Manufacturing	do	74.5	80.3	87.1	+8.5
Contract construction	do	31.8	34.7	34.7	--
Transportation and public utilities	do	29.2	31.7	34.0	+7.3
Wholesale and retail trade	do	117.8	126.8	133.1	+5.0
Finance, insurance, real estate	do	22.3	24.3	26.1	+7.4
Services	do	82.3	90.9	97.4	+7.2
Government	do	115.8	121.0	123.7	+2.2
Total nonagricultural employment[1]	do	488.7	[2]525.4	553.9	+5.4
Personal income:					
Total	millions	$7,517.0	$8,622.0	$9,822.0	+13.9
Per capita		$5,919.0	$6,594.0	$7,185.0	+9.0
Construction activity:					
Number of private and public residential units authorized		22,191.0	[3]21,181.0	16,532.0	-21.9
Value of nonresidential construction	millions	$173.1	$260.5	$306.9	+17.8
Value of State road contract awards	do	$55.0	$60.0	$77.0	+28.3
Shipments of portland and masonry cement to and within the state	thousand short tons	902.0	903.0	923.0	+2.2
Nonfuel mineral production value:					
Total crude mineral value	millions	$497.2	$552.6	$753.4	+36.3
Value per capita, resident population		$385	$452	$551	+21.9
Value per square mile		$5,855	$6,958	$8,872	+27.5

[p] Preliminary.
[1] Includes bituminous coal and oil and gas extraction.
[2] Data do not add to total shown because of independent rounding.
[3] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

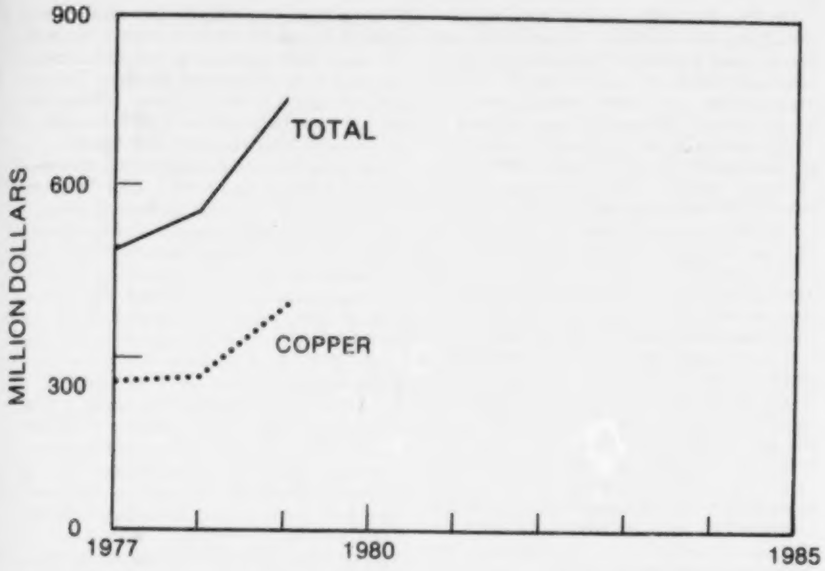

Figure 1.—Value of mine production of copper and total value of nonfuel mineral production in Utah.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Beryllium.—Brush Wellman, Inc., mined bertrandite at its Spor Mountain property in Juab County during 1978-79. This ore and imported beryl were converted to beryllium hydroxide at the company facilities near Delta. Construction, adjacent to the bertrandite mill, was completed in 1978 on the new plant for extracting beryllium from beryl ores. Plans were announced in October 1979, for a $6 million expansion of the bertrandite ore processing plant to incorporate technological advances and to add 25% capacity.

In 1979, Brush Wellman obtained, from the Anaconda Co., a lease and option to purchase additional properties containing beryllium-bearing ores in Juab County. In January 1980, the company intends to exercise the option to purchase the properties near Brush Wellman's open pit mines.

Beryllium hydroxide is processed at the company's plant in Elmore, Ohio, to produce beryllium metal, beryllium-copper, beryllium oxide, and other alloys. The materials are used as metal in nuclear reactors and in aerospace applications, as an alloy in electrical equipment, and in electronic components.

Copper.—The Utah Copper Div. of Kennecott Minerals Co., a division of Kennecott Copper Corp., operates the world's largest open pit copper mine at Bingham, 25 miles southwest of Salt Lake City. In 1978, the excavation from east to west was over 2.3 miles wide at the top and 1/2-mile deep. That year, total material handled averaged 485,427 tons per day including 103,000 tons of ore. On November 3, 1977, a world record in hard rock mining was set when mine personnel moved 544,808 tons of material in 24 hours. In 1977, the average grade of ore was 0.617% copper; in 1978 the average grade dipped to 0.6%; and in 1979, dipped again to 0.586%.

Other facilities of the operation include the world's largest precipitation plant located at the mouth of Bingham Canyon; and about 16 miles to the north are the Bonneville, Arthur, and Magna concentrators; the smelter; and refinery.

On May 30, 1978, the company completed modifying the Garfield smelter. The new process uses a modified Noranda continuous smelting system for converting the sulfide concentrates and leach precipitates into blister copper. The project was initiated in 1972; contracts for engineering and construction were let in 1973; and construction of a new 1,200-foot stack started in November 1973. It was completed in 1975. The first reactor was brought onstream in late 1977, and the changeover to the new system was completed in May 1978. Built at a cost of $280 million, approaching $300 million including startup expense, the new facilities were installed primarily for pollution control and yielded no increase in the design capacity of 270,000 short tons per year. Problems encountered in the startup period in 1978 and in the first 9 months of 1979 in the gas-handling facilities, converters, and hot-metal transfers kept the smelter from achieving production goals in 1979. The modified smelter captures 86% of the sulfur contained in the plant feed, compared with 55% in the old plant. A description of the project was published in 1979.[8]

Molybdenum, gold, silver, and sulfuric acid were the most important byproducts recovered in 1978-79 from the Bingham porphyry copper ores. When economically feasible, other byproducts obtained from the ores included bismuth, palladium, platinum, rhenium, selenium, and tellurium.

In July 1979, Kennecott announced that the Magna mill, which the old Utah Copper Co. built in 1908, and the Arthur mill, which Boston Consolidated Co. built in 1909, would be replaced by additions to the Bonneville concentrator built in the mid-1960's to supplement crushing and grinding operations of the two old mills.

Kennecott is the State's largest private employer; nearly 2,650 people are employed at the mine and approximately 7,000 people are employed at the Utah Copper Div.

Other significant copper producers in 1978 were the Trixie Mine of Kennecott in the East Tintic mining district, Utah County; and Kennecott's Mammoth Mine in the Tintic mining district, Juab County. In 1979, other copper producers included the new Carr Fork Mine of Anaconda in Tooele County.

The Anaconda Co., subsidiary of Atlantic Richfield Co., shipped the first concentrate from its Carr Fork Mine on August 31, 1979. The Carr Fork underground copper mine is adjacent to the Kennecott Bingham Canyon open pit mine in the Bingham mining district; surface facilities are in Pine Canyon, 1 mile west of Bingham, in Tooele County.

The property was acquired from National Tunnel & Mines Co. in 1948. After 20 years of exploration, in 1969, geological evaluations and a drilling program of the property delineated the Yampa and Highland Boy ore bodies by 1973. On September 6, 1974, the Anaconda board approved appropriation of $200 million to develop the Carr Fork Mine; and shaft sinking commenced in early 1975. Four circular, concrete-lined shafts will service the Carr Fork Mine.

Copper mineralization averaging 1.85% production-grade copper consists of chalcopyrite associated with pyrite and molybdenite, gold, and silver byproducts. Mining methods considered included conventional blast-hole methods and Canadian Industry Ltd.'s patented "Vertical Crater Retreat" method. The $220 million operation is expected to recover 41,000 to 55,000 tons per year of copper. Eight hundred people are employed at the Carr Fork Project. Several articles describe the new project.[9]

Gold.—In 1978, Utah ranked third in the Nation in gold production; however, by 1979, the State rose to first place. The principal producer, in 1978-79, continued to be the Utah Copper Div. of Kennecott Copper Corp., followed by Kennecott's Trixie Mine in the East Tintic mining district, Utah County. Other producers recovering gold in 1978 included the Burgin Mine of Kennecott in the East Tintic district and the Ontario Mine of Park City Ventures in Summit County. In 1979, the new Carr Fork Mine of the Anaconda Co. recovered gold from its copper ores. Gold was obtained from eight operations in four counties in 1978 and from seven operations in four counties in 1979. The Mammoth Mine of Kennecott in the Tintic district, Juab County, continued producing gold throughout the biennium.

Iron Ore.—All iron produced in the State was obtained from open pit operations in Iron County. In 1978-79, CF&I Steel Corp. direct-shipped iron ore from the Comstock

Table 4.—Utah: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by county

County	Lode mines producing	Material sold or treated (metric tons)	Gold		Silver	
			Troy ounces	Value	Troy ounces	Value
1977, total	6	29,986,342	210,501	$31,219,403	3,283,323	$15,168,953
1978:						
Juab	1	9,356	1,539	297,873	97,159	524,659
Salt Lake	2	32,630,762	W	W	W	W
Summit	1	8,550	71	13,742	36,551	197,375
Utah	4	143,365	W	W	W	W
Undistributed	--	--	234,319	45,352,443	2,751,355	14,857,317
Total	8	32,792,033	235,929	45,664,058	2,885,065	15,579,351
1979:						
Juab	1	895	145	44,588	8,436	93,555
Salt Lake	4	34,326,310	W	W	W	W
Undistributed[1]	2	85,281	260,771	80,187,084	2,445,700	27,122,812
Total	7	34,412,486	260,916	80,231,672	2,454,136	27,216,367

County	Copper		Lead		Zinc		Total value
	Metric tons	Value	Metric tons	Value	Metric tons	Value	
1977, total	176,111	$259,357,381	9,749	$6,598,314	16,111	$12,218,156	$324,562,207
1978:							
Juab	58	84,593	--	--	--	--	907,125
Salt Lake	185,713	272,268,534	W	W	W	W	326,334,957
Summit	7	10,077	567	421,195	711	485,728	1,128,117
Utah	553	811,314	W	W	W	W	10,333,468
Undistributed	--	--	1,974	1,466,657	2,798	1,912,160	--
Total	[2]186,330	273,174,518	2,541	1,887,852	3,509	2,397,888	338,703,667
1979:							
Juab	9	17,808	--	--	--	--	155,951
Salt Lake	192,614	395,044,228	W	W	W	W	496,956,481
Undistributed[1]	459	940,833	--	--	--	--	6,353,109
Total	193,082	396,002,869	W	W	W	W	503,465,541

W Withheld to avoid disclosing company proprietary data; included in "Undistributed" in 1978; gold and silver included in "Undistributed" in 1979; lead and zinc excluded from totals in 1979.

[1] Includes Tooele and Utah Counties and gold and silver in Salt lake County.

[2] Data do not add to total shown because of independent rounding.

Table 5.—Utah: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by class of ore or other source material

Source	Number of mines[1]	Material sold or treated (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
1978							
Lode ore:							
Gold-silver and silver[2]	3	71,076	[3]235,704	[3]2,732,571	600	W	W
Copper	1	32,602,142	W	W	165,441	--	--
Lead and lead-zinc[2]	4	94,277	225	152,494	23	[4]2,541	[4]3,509
Total[5]	8	[5]32,767,496	235,929	2,885,065	166,064	2,541	3,509
Other lode material:							
Copper precipitates	1	24,538	--	--	20,266	--	--
Grand total[5]	8	32,792,033	235,929	2,885,065	186,330	2,541	3,509
1979							
Lode ore:							
Gold-silver, copper, lead[2]	6	34,381,598	260,716	2,441,010	172,127	W	W
Other lode material:							
Copper precipitates	1	26,360	--	--	20,944	--	--
Copper tailings	1	4,528	200	13,126	11	--	--
Total lode material[5]	7	34,412,486	260,916	2,454,136	193,082	W	W

W Withheld to avoid disclosing company proprietary data.

[1] Detail will not add to total because some mines produce more than one class of material.

[2] Combined to avoid disclosing company proprietary data.

[3] Includes gold and silver from copper ore.

[4] Includes lead and zinc from silver ore.

[5] Data may not add to totals shown because of independent rounding.

Table 6.—Utah: Mine production (recoverable) of gold, silver, copper, lead, and zinc, by type of material processed and method of recovery

Type of material processed and method of recovery	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
1978					
Lode:					
Smelting of concentrates	218,138	2,345,226	165,469	2,541	3,509
Direct smelting of:					
Ore	17,791	539,839	595	--	--
Copper precipitates	--	--	20,266	--	--
Total	235,929	2,885,065	186,330	2,541	3,509
1979					
Lode:					
Smelting of concentrates	250,965	2,165,575	171,833	--	--
Direct smelting of:					
Ore	9,951	288,561	305	W	W
Copper precipitates	--	--	20,944	--	--
Total	260,916	2,454,136	193,082	W	W

W Withheld to avoid disclosing company proprietary data.

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Mine in the Pinto mining district about 13 miles west of Cedar City; United States Steel Corp. direct-shipped ore from the Mountain Lion mine; and Utah International, Inc., mined and concentrated a lower grade ore at the Thompson and Iron Springs mines. Iron ore in the county was shipped to the CF&I Steel Corp. steel plant in Pueblo, Colo., and to the United States Steel Geneva Works, near Provo, Utah. The Geneva Works also obtained iron ore from Atlantic City, Fremont County, Wyo. Various raw materials for the operation of this plant were obtained from mines in Colorado, Nevada, Utah, and Wyoming. Crude ore shipped in 1978 increased 2% in amount and 7% in value in 1978, then in 1979, decreased 18% in amount and 9% in value.

Utah's second largest employer, the Geneva Works, is one of the largest steelmaking facilities in the West, with an annual capacity of about 2.5 million ingot tons. The principal products from this fully integrated steel plant are plates, hot-rolled sheets and coils, structural shapes, welded steel pipe, pig iron, metallurgical coke, blast furnace and open hearth slag products, and coal chemicals and nitrogen products for fertilizer and industrial use.

In 1978, a new $9 million bag house air-cleaning facility began operation at the Geneva Works. The equipment is designed to allow burning of low-sulfur coal in the powerhouse boilers year-round as a supplemental fuel to blast furnace gas and to reduce particulate emissions from the powerhouse. In 1979, United States Steel and EPA negotiated over the air pollution controls necessary to limit emissions at the Geneva plant.

Early in 1979, Nucor Corp., of Charlotte, N.C., announced plans to construct a mini-steel mill on a 600-acre site at Riverside in Box Elder County. Scheduled for construction in 1980-81, the mill was expected to cost $45 million and produce about 350,000 tons per year of alloy and carbon steel angles, flats, channels, and rounds. Operation of the plant will require about 250 people.

Lead.—Utah was ranked fourth in domestic production of lead in 1978, but with the closing of Kennecott's Burgin Mine in the East Tintic mining district, Utah County, and the Ontario mine of Park City Ventures in Park City mining district, Summit County, lead production plummeted to 12th place in 1979.

The lead-zinc mining and milling operations at the Park City Ventures Ontario Mine, were closed February 15, 1978. The closure affected about 350 mine and mill workers. A company spokesman said that high costs caused by water and rock problems forced the shutdown. Park City Ventures, a 60-40 joint venture of the Anaconda Co. and ASARCO, Inc., had been operating the mine under lease from United Park City Mines Co. since 1971.

On May 22, 1979, Noranda Mines Exploration, Inc., a subsidiary of Noranda Mines, Ltd., reportedly paid Park City Ventures $300,000 for an option to lease the United Park City Mines Co. property. Noranda Mines Exploration reportedly paid an additional $200,000 and exercised its option to purchase the lease on August 22, 1979; thereafter Noranda will pay Ventures $3 million in $1 million annual installments. Advance royalties paid by Ventures to United Park will be continued by Noranda, plus a share of any net profits. Throughout the rest of the year, Noranda continued to rehabilitate the mine and mill and explore the property.

Utah's last remaining lead-zinc mining operation, Kennecott's Tintic Div. Burgin Mine near Eureka, was closed in July 1978. Kennecott leased the Burgin property from Chief Consolidated Mining Co. and from the Tintic group - composed of South Standard Mining Co. and Amax-Arizona, Inc. The Burgin Mine has yielded substantial production since Kennecott began operations in 1963; however, a diversity of problems—including large volumes of hot, brackish water, internal heat, and unstable ground conditions—made mining unprofitable, particularly with current depressed zinc prices.[9] Kennecott's operations continued at the Trixie Mine, a profitable gold and silver producer in the same general area. The company retained possession of its 750-ton-per-day mill and has made it available for treating ores from lessee operations in the district.

The two base-metal operations, the Ontario and the Burgin mines, also recovered substantial amounts of gold, silver, and zinc. Closing of the two mines was reflected in the decrease in lead production in the State.

Magnesium.—NL Industries, Inc., Magnesium Div., recovers magnesium metal and byproduct chlorine at its Rowley plant, on the southwest shore of the Great Salt Lake in Tooele County. The products are extracted from brine waters of the Great Salt Lake in a complex process that includes solar evaporation, chemical treatment, melting, purification, and electrolysis of the salt melt. The operation represents an investment of more than $160 million.

According to the company, in 1978, its first full year of production, the plant was operated at approximately a 25,000-ton-per-year level, "the present design capacity." Major improvements included increased electrolytic-cell output, and reduced maintenance and process chemical costs, resulting in a reduction of 55% in operating losses. In 1979, the board of directors approved selling the magnesium facility to focus their resources in other operations, particularly petroleum services; and the company held preliminary discussions with prospective purchasers.

Molybdenum.—Molybdenum was recovered as a byproduct of copper production at the Utah Copper Div. of Kennecott Copper Corp., the only molybdenum producer in the State. In 1978, the amount of molybdenum shipped increased 42%; and the value of the shipments rose 101%, partly because of the increase in price. In 1979, molybdenum shipped increased 11%, and value of the shipments increased 32%. The average domestic unit price per pound of molybdenum in concentrate was $3.60 in 1977, $4.65 in 1978, and $6.07 in 1979.

In January 1978, Phelps Dodge Corp. announced the discovery of porphyry-like molybdenum mineralization with minor tungsten values in the old Pine Grove mining district southwest of Milford, Beaver County. The discovery was made in a hole drilled between October 1975 and April 1976. The first four deep diamond drill holes intersected significant lengths of molybdenum mineralization between 3,000 and 5,000 feet. The lengths of mineralization at a cutoff grade of 0.2% MoS_2 ranged from a maximum of 950 feet to a minimum of 200 feet, although two of the holes were terminated without bottoming the mineralization. On May 8, 1978, Phelps Dodge Corp. and Getty Oil Co. entered a joint-venture agreement, called the Pine Grove Associates, for evaluating and, if warranted, developing the deposit. Under terms of the agreement, Getty has the right to acquire 52% interest in the property by spending $45 million in a deep-drilling program. If successful, the project would take a minimum of 10 years to develop. In the initial phase, four deep diamond drill holes were scheduled to be drilled at a cost of $250,000 each and the surface of the property mapped.

Selenium.—Utah Copper Div. of Kennecott Copper Corp. recovered selenium as a byproduct from refining of copper ores. In 1979, production was above that of the previous year.

Silver.—Kennecott Copper Corp., Utah Copper Div., again led the State in the production of silver, which was recovered as a byproduct from the Bingham district. Kennecott's Trixie and Burgin mines in Utah County and the Ontario Mine of Park City Ventures in Summit County were significant producers in 1978. By 1979, closing the Ontario and the Burgin contributed to the decline in amount of output. Silver was recovered from ores shipped from eight mines in four counties in 1978 and from seven mines in four counties in 1979.

With the increase in the price of silver, Ranchers Exploration and Development Corp. reevaluated its Escalante silver mine project in the Escalante mining district, Iron County. According to the 1979 company annual report, the deposit contains more than 1.8 million tons of ore with a silver content of 10 ounces per ton, plus small amounts of lead and zinc. In September 1979, the company began a pilot mining project which involved excavating a 1,000-foot decline to intersect the vein and 1,000 feet of development work in the vein. The 8-month project will enable the company to verify mineralization and grade, to evaluate rock and water conditions, and to obtain bulk samples for metallurgical testing. An estimated 40,000 gallons of water per minute may have to be pumped from the workings.

Tungsten.—Small amounts of scheelite tungsten ore were mined in Utah during 1978-79. In Box Elder County, Sorenson and Collier shipped from the Sun Uranium Mine near Lucin in 1978-79, and Condor Industries shipped in 1978. In Tooele County, Abracadabra Exploration Corp. made shipments in 1978-79 from the Fraction Lode, C&P Leasing from the Star Dust mines at Gold Hill, and Bunker Tungsten Co. from the Glen Dale Ranch. Steve Studdert shipped from a mine in Davis County in both years. As the price of tungsten declined, production and the value of produced metal both trended heavily downward.

Vanadium.—Vanadium is obtained from the uranium-vanadium deposits of the Colorado Plateau. Most of the output comes from San Juan County where vanadium was recovered from the uranium-vanadium ores of 21 mines in 1978 and 34 mines in 1979. Emery, Garfield, and Grand Counties also had some production. Ores were shipped to Union Carbide Corp. concentrators in Rifle and Uravan, Colo., and to the Atlas Corp. plant near Moab, Utah. Of the five producing States in 1978, Utah ranked second in amount and value of production; and in 1979, the State was second in amount and third in value of production.

Energy Fuels Nuclear, Inc., in 1978, began constructing a $30 million uranium-vanadium ore-buying station and 2,000-ton-per-day concentrator at White Mesa, 6 miles south of Blanding, San Juan County. Ore had been stockpiled at the mill site since 1977. Feed for the mill will be obtained from Energy Fuel mines and independent mines in the area.

Zinc.—The drastic decline in zinc production in the State was principally related to low zinc prices and the closing of the Burgin Mine in the East Tintic district and the Ontario mine in the Park City district in 1978. Although the two mines recovered gold and silver from the base-metal ores, lead and zinc were the principal commodities mined.

In 1978, there were five zinc producers in four counties. By 1979, zinc production in the State was negligible, only one mine recovered zinc. The average unit price of zinc was $0.3440 per pound in 1977, $0.31 per pound in 1978, and $0.3730 per pound in 1979.

Zirconium.—In July 1978, Western Zirconium, Inc., began construction of a $50 million plant to produce zirconium alloy in the Southern Pacific Industrial Park, 12 miles southwest of Ogden, Weber County. Initially, zircon sand ores will be imported from Australia and processed to produce 3 to 4 million pounds per year of zirconium alloy which is used to contain nuclear fuel in water-cooled nuclear powerplants. Production was expected in 1980.

NONMETALS

Native Asphalt and Other Bitumens.—Gilsonite was produced by American Gilsonite Co. at Bonanza, Utah, in Uinta County, and by the Ziegler Chemical & Mineral Corp. in Weber County. By mid-1979, American Gilsonite completed its $5.3 million consolidated processing plant at Bonanza.

Cement.—Portland Cement Co. of Utah manufactured portland cement at its plant in Salt Lake City. The Ideal Cement Co., Div. of Ideal Basic Industries, Inc., quarried limestone and shipped portland and masonry cement from its Devils Slide plant site in Morgan County.

Portland Cement Co. mined cement rock at its Parley's Canyon quarry 12 miles east of Salt Lake City and quarried a small amount of high-grade limestone at its Grantsville property in Tooele County. Raw material from primary and secondary crushing operations at both quarries was shipped to the company's 3-kiln, wet-process cement plant in Salt Lake City for processing.

In 1978, production capacity was 260,000 tons of cement per year; however, an expansion program completed in 1979 brought the plant capacity up to 420,000 tons per year. On September 13, 1979, Lone Star Industries, Inc., acquired Portland Cement Co. of Utah for $38 million cash. Earlier in the year, Lone Star had disclosed plans to build a 500,000 ton-per-year cement plant on the site Portland Cement Co. owns near Grantsville, 45 miles west of Salt Lake city.

Plans for modernizing and expanding the Ideal Cement Devils Slide plant in Weber Canyon were revealed in 1979. Operated by the company since 1908, the plant now has a 360,000-ton-per-year capacity. Studies have indicated adequate resources in the area to support the planned 1-million-ton-per-year cement manufacturing facility.

Further developments included Martin Marietta Corp.'s announced construction of an $85 million cement plant approximately 105 miles south of Salt Lake City in Leamington, Millard County. Construction of the 650,000-ton-per-year facility was to begin during the summer of 1980 and to be completed by mid-1982. The estimate includes construction costs, the cost of establishing marketing terminals in Salt Lake City, and associated engineering and management costs.

Clay and Shale.—In 1978-79, companies mining common clay shale in Utah included Utelite Corp. in Summit County; Mountain Fuel Supply's Entrada Industries in Salt Lake, Summit, Tooele, and Utah Counties; and Interpace Corp. in Sevier, Utah, and Weber Counties. Redmond Clay and Salt Co. and Azome Utah Mining Co. in Sanpete County, mined bentonite. Western Clay in Sevier County, shipped fuller's earth, and R. D. Wadley Clay Co. in Utah County shipped fire clay. In 1979, Western Clay Co. mined bentonite and fuller's earth in Sevier County. Clay was used principally in manufacturing brick and concrete block and in structural concrete. Smaller quantities were used in oil-refinery catalysts, waterproofing compositions, drilling mud, animal feed, and fertilizers.

Interstate Brick Corp., a division of Entrada Industries, a subsidiary of Mountain Fuel Supply Co., added a multimillion dollar kiln and manufacturing facility to its West Jordan plant. Designed to increase production capacity by 56%, the kiln is 20 feet wide and 400 feet long—one of the widest in the United States—and will produce 40 million bricks annually. Interstate's Salt Lake County Cottonwood clay pits are in the Big Cottonwood mining district.

Fluorspar.—No fluorspar production was recorded for the State in 1978-79. Fluorspar had been produced from mines in Juab County.

Gem Stones.—Individuals—amateurs and professionals—collected gem-stone material and mineral specimens from various areas in the State during the biennium. Because no large companies mine gems in the State, information is incomplete; however, the Bureau of Mines estimates value of production was $75,000 in 1978-79. Two items of interest appeared in the literature.[4]

Graphite (Synthetic).—Synthetic graphite is produced at Hercules, Inc., Aerospace Div., Graphite Fibers Department. The plant, built in 1970, is located at Hercules Bacchus Works near Magna in western Salt Lake County. Manufactured graphite fiber is used as a lightweight, high-strength structural material in military and commercial aircraft, spacecraft, missiles, industrial equipment, and sporting goods.

Gypsum.—Georgia Pacific Corp. and United States Gypsum Corp. mined gypsum for use in the manufacture of plaster and wallboard at plants in the Sigurd Area, Sevier County. These companies have the largest gypsum operations in the State and are major employers in the nonagricultural sector in the area. Other companies with active gypsum operations included Thomas J. Peck & Sons with an open pit mine at Nephi, Juab County; White Mountain Gypsum Co. with a mill at Fillmore, Millard County; Cox Enterprises, Inc., in Sanpete County; and Buttes Gas and Oil Co. in Emery County.

Crude gypsum is calcined for manufacturing plasters and wallboard and marketed for use as a cement retarder, as a soil neutralizer in agriculture, and as a filler.

Lime.—In 1978-79, Utah Marblehead Lime Co. and Flintkote Co., U.S. Lime Div., in Tooele County, were the largest producers of lime in the State; in 1978, the Kennecott Copper Co., Utah Copper Div., Salt Lake County, and Utah-Idaho Sugar Co. in Box Elder County, followed in amount of production. Utah-Idaho Sugar Co. did not report lime production in 1979. Lime is used for refractories, mason's lime, flotation of sulfide copper ores, and for sugar refining.

Utah Marblehead Lime Co., a subsidiary of General Dynamics Corp., announced construction of a $1.1 million pollution-control facility at its Tooele plant in the Lakeside mining district. The new facility will improve collection of particulate matter from its limestone operation.

In December 1978, the Steel Bros. Canada, Ltd., of Vancouver, B.C., announced plans for a $7 million, 500-ton-per-day quicklime plant south of Delta. The plant will produce quicklime for use in flue gas scrubbers at powerplants and other industrial plants. Limestone ore for the plant will be mined from an open pit deposit in the Cricket Mountains. The Canadian company's operation in Utah is to be handled by its subsidiary, Continental Lime, Inc., of Utah. Construction began in 1979 with completion scheduled for 1980.

Magnesium Compounds.—Great Salt Lake Minerals and Chemical Corp, a subsidiary of Gulf Resources and Chemical Corp., recovered magnesium chloride and other compounds from the brines of Great Salt Lake. The solar evaporation and processing plant is located on the east shore of the lake west of Ogden in Weber County. The magnesium chloride was reported to be used mainly for dust control particularly in the sugar beet industry.

Kaiser Aluminum and Chemical Corp. also recovered magnesium chloride and other compounds from its Bonneville, Ltd., operation on the Bonneville Salt Flats near Wendover in Tooele County.

Perlite.—Crude perlite was shipped from the Mountain Maid Mine near Fillmore, Millard County. The Pax Co. produced expanded perlite at its plant in Salt Lake City while Georgia Pacific Corp. did likewise at its facilities in Sigurd, Sevier County. The product was used principally for horticultural aggregate, insulation, concrete, and plaster aggregates. In 1979, production of expanded perlite increased in both amount and value over that of 1978.

Phosphate.—Stauffer Chemical Co. again was the only phosphate producer in the State during 1978-79. Phosphate rock was mined and processed at the company's facilities near Vernal, Uintah County. Stauffer reported mining operations were expanded in 1979.

Potash.—The three companies producing potash in the State, Texasgulf, Inc., Great Salt Lake Minerals and Chemicals Corp., and Kaiser Aluminum and Chemical Corp., used solar evaporation in processing their products. Weather played an important part in the success of the operations.

Texasgulf, Inc., recovered potash by solution mining at its Cane Creek properties, west of Moab, Grand County, where the ore occurs at a depth of 2,800 feet. Sodium and potassium brines concentrated in solar ponds, harvested by scrapers, slurried, and pumped to the concentrator where froth flotation was used to produce 60% K_2O muriate of potash concentrate from the evaporite. In 1978, the company installed a scrubber which was expected to remove 99% of the potash fines from the dryer stack of the processing plant. Texasgulf ships its muriate of potash from Cane Creek to domestic fertilizer mixers and blenders and then to markets in Australia, Central and South America, and New Zealand. The company announced plans in 1979 to move into industrial salt production. Six million tons of salt had been recovered as a byproduct of potash production and stored at the Moab facility.

Great Salt Lake Minerals and Chemicals Corp. obtains its brine supply from the northern half of Great Salt Lake where the potassium content is 50% higher than at the southern half. Brines are fed to solar-evaporation ponds where potassium-rich salts are harvested after the halite and magnesium sulfate are crystallized. A froth-flotation circuit constructed at the plant in 1975 was used to recover the sulfate of potassium. The plant is the largest producer of potassium sulfate in the United States.

At the Kaiser Aluminum & Chemical Corp.'s Bonneville Ltd., plant, brines near the surface are collected in an extensive system of canals cut about 14 feet deep to the bottom of the salt bed. After the precipitation of halite and gypsum, sylvinite crystals are harvested in solar ponds. Froth flotation is used to recover 60% K_2O muriate of potash concentrate from the sylvinite-like evaporite. New evaporation ponds and 40 miles of collecting canals, dikes, and baffles being constructed in the late 1970's were to be completed by 1980. In October of 1978, a fire completely destroyed the old flotation plant; but by March 1979, a new $2.1 million, 350-ton-per-day flotation plant had been rebuilt on the site. The company employs 58 workers.

Pumice.—Fillmore Products, Inc., west of Fillmore in Millard County, continued to be the State's only supplier of pumiceous material. Most of the processed volcanic cinders were used for landscaping and the remainder for concrete aggregate.

Salt.—Producers of salt in 1978 included Great Salt Lake Minerals and Chemicals Corp., in Weber County; Utah Salt Co., American Salt Co., Hardy Salt Co., and Lakepoint Salt Co., all in Tooele County; Morton Salt Co. in Salt Lake County; Redmond Clay & Salt Co., in Sevier County; Lake Crystal Salt Co., in Box Elder County; and Moab Brine (La Sal Oil), in Grand County. Evaporated salt was produced in Box Elder, Tooele, and Weber Counties; brine in Grand County; and rock salt in Sevier County.

Great Salt Lake Minerals and Chemicals Corp., a subsidiary of Gulf Resources & Chemical Corp., constructed a $4.5 million salt processing plant at its operation west of Ogden on the east shore of Great Salt Lake. Completed October 1979, the new plant is to increase the company's salt-producing capacity to 600,000 tons per year and free existing salt-production circuits for the increased output of potassium sulfate. The plant features drying, screening, and mineralizing equipment; blocking, pelletizing, and high-speed bagging lines; and warehousing and loading facilities. In addition to the 240 persons working at the plant, another 50 people will be employed.

Salt deposits in the Paradox Basin in southeast Utah were being investigated for the storage of radioactive waste that comes from military projects and nuclear plants. In Salt Valley, 25 miles northwest of Moab, three deep-hole explorations from 1,300 to 4,000 feet were completed in 1978. Lisbon Valley was also being studied as a storage site. Because salt is dry, disperses heat rapidly, and is plastic, allowing fractures to heal, it is proposed as a good material for burying the radioactive substances.

Sand and Gravel.—Sand and gravel was mined at 72 deposits by 59 operators, including 19 county and State highway departments, in 1978. Most production was obtained from deposits close to population centers in Cache, Davis, Salt Lake, Sanpete, Tooele, Utah, and Weber Counties. In 1978, sand and gravel sold or used in Davis, Salt Lake, Sanpete, and Utah Counties accounted for 75% of the State's total. Construction sand and gravel production and value increased in 1978; but both were off in 1979. Industrial sand and gravel production, in 1978, declined in amount and value, but remained the same in amount and value in 1979. Among the nonmetallic commodities, sand and gravel remained in third place, outranked only by cement and potassium salts.

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Table 7.—Utah: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,266	$6,059	$1.86	4,091	$7,802	$1.91	3,362	$6,373	$1.90
Plaster and gunite sands	NA	NA	NA	W	W	2.76	W	W	1.57
Concrete products	151	302	2.00	W	W	2.05	W	W	2.05
Asphaltic concrete	2,290	3,785	1.65	2,216	4,050	1.83	1,713	3,584	2.09
Roadbase and coverings	3,545	5,695	1.61	4,004	6,798	1.70	3,168	6,075	1.92
Fill	2,430	2,544	1.05	1,869	2,408	1.29	1,657	1,694	1.02
Snow and ice control	NA	NA	NA	--	--	--	--	--	--
Other uses	214	277	1.30	203	362	1.78	179	339	1.90
Total[1] or average	11,895	18,662	1.57	12,580	21,840	1.74	10,363	18,621	1.80

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Table 8.—Utah: Construction sand and gravel sold or used by producers

	1977			1978			1979		
	Quantity (thousand short tons	Value (thousands)	Value per ton	Quantity (thousand short tons	Value (thousands)	Value per ton	Quantity (thousand short tons	Value (thousands)	Value per ton
Sand	3,645	$5,625	$1.54	4,247	$7,515	$1.77	2,643	$5,192	$1.96
Gravel	8,251	13,037	1.58	8,338	14,320	1.72	7,720	13,429	1.74
Total[1] or average	11,895	18,662	1.57	12,580	21,840	1.74	10,363	18,621	1.80

W Withheld to avoid disclosing company proprietary data.

[1] Data may not add to totals shown because of independent rounding.

Table 9.—Utah: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate	42	96	--	--	2	7
Bituminous aggregate	--	--	--	--	44	110
Dense-graded roadbase stone	70	150	W	W	39	127
Surface treatment aggregate	W	W	W	W	188	655
Other construction aggregate and roadstone	37	63	35	84	W	W
Cement manufacture	1,037	2,870	1,002	2,803	1,069	3,426
Fill	4	9	--	--	--	--
Bedding material	([2])	1	--	--	--	--
Dam construction	--	--	--	--	45	89
Other uses[3]	1,575	3,883	1,780	6,829	2,036	6,645
Total[4]	2,765	7,072	2,817	9,716	3,424	11,059

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite (1977-78), marble, sandstone, and other stone.

[2] Less than 1/2 unit.

[3] Includes stone used in agricultural limestone (1977), poultry grit and mineral food (1978-79), riprap and jetty stone, railroad ballast, terrazzo and exposed aggregate, lime manufacture, dead burned dolomite (1977-78), flux stone, refractory stone (1978-79), mine dusting, chemicals (1978), unspecified uses, and uses indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

Sodium Sulfate.—Great Salt Lake Minerals and Chemicals Corp. continued to recover sodium sulfate at its operation near Ogden. Magnesium chloride, potassium sulfate, sodium sulfate, and salt were recovered from the brines of Great Salt Lake. Sodium sulfate production decreased in amount and value in 1978, but recovered substantially in 1979.

Stone.—Fifteen companies quarried stone from 23 quarries in 15 counties in 1978, and from 35 quarries in 15 counties in 1979. Principal producers in both years included United States Steel Corp.; Ideal Basic Industries, Inc.; Portland Cement Co. of Utah; U.S. Lime Div. of Flintkote Co.; Southern Pacific Railroad Co.; and U.S. Marblehead Lime Co. a division of General Dynamics, Inc. The crushed stone was used mainly for flux, cement, riprap jetty, and deadburned dolomite. The Cache County Road Department used crushed limestone for dense road base. Box Elder, Morgan, Salt Lake, Tooele, and Utah were the principal producing counties in 1978-79.

Four companies mined dimension stone: Star Stone Co., Inc., quarried sandstone in Box Elder County for rough blocks and flagging; W.A. Hansen Stone Quarry, Inc., quarried sandstone in Summit County for house-stone veneer and sawed building stone; the Cleo and Raggie Teeter operation quarried irregular sandstone in Box Elder County; and Utah Scenic Stone quarried sandstone for sawed building stone in Washington County. Other uses for stone included surface treatment, mine dusting, poultry grit, and dam construction.

Vermiculite.—Although no crude vermiculite was produced in Utah in 1977-78, Vermiculite Intermountain Inc., continued to exfoliate vermiculite from out-of-State sources. In 1978, 50% of the product was used for concrete aggregate; most of the remainder went for loose-fill insulation and fireproofing. The following year, about 60% of the product was used for vermiculite block; the remainder went for concrete aggregate, loose-fill insulation, fireproofing, pipe covering, plaster, and soil conditioner.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Asphalt:			
American Gilsonite Co	Suite 1150, Kennecott Bldg. Salt Lake City, UT 84133	Underground mine and plant	Uintah.
Beryllium:			
Brush Wellman, Inc	67 West 2950 South Salt Lake City, UT 84115	Open pit mines and plant	Juab and Millard.
Cement:			
Ideal Basic Industries, Inc.[1]	Cement Div. Star Route Morgan, UT 84050	Open pit mine and plant	Morgan.
Portland Cement Co. of Utah[1]	615 West 800 South Box 1469 Salt Lake City, UT 84110	Quarries and plant	Salt Lake and Tooele.
Clays:			
Interpace Corp	736 West Harrisville Rd. Ogden, UT 84017	Open pit mine and plant	Box Elder, Salt Lake, Sevier, Utah, Weber.
Mountain Fuel Supply Co., Entrada Industries, Interstate Brick Corp.	9210 South 5200 West Box 517 West Jordan, UT 84084	Open pit mines	Piute, Salt Lake, Tooele, Utah.
Utelite Corp	Box 387 Coalville, UT 84017	Open pit mine and plant	Summit.
Copper:			
Kennecott Copper Corp.[2]	Box 11299 Salt Lake City, UT 84147	Open pit mine, mills, smelter, refinery.	Salt Lake and Utah.
The Anaconda Co., Mineral Resources Group.[3]	Tooele, UT 84074	Underground mine and mill	Tooele.

See footnotes at end of table.

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[1] State mineral specialist, Bureau of Mines, Denver, Colo.

[2] Dayton, S. (ed.). Utah Copper and the $280 Million Investment in Clean Air. Eng. and Min. J., v. 180, No. 4, April 1979, pp. 72-83.

[3] Ditto, A. Development of the Carr Fork Project. Min. Cong. J., v. 65, No. 12, December 1979, pp. 49-53.

Skillings,Jr.,D.N. Anaconda's Carr Fork Copper Project in Utah. Skilling's Min. Rev., v. 67, No. 26, July 1, 1978, pp. 1, 10-14.

Jackson D. (ed.). Carr Fork: New Mine, Old District. Eng. and Min. J., v. 80, No. 1, January 1979, pp. 70-77.

Pay Dirt. (Intermountain edition) $217 Million Carr Fork Project Comes On Stream on Schedule and Near Budget. October 1979, No. 1, pp. A-1-A-7.

[4] Ream, L. R. The Thomas Range, Wah Wah Mountains, and Vicinity, Western Utah. Mineral. Rec., v. 10, No. 5, September-October 1979, 10, No. 5, pp. 261-278.

Smith, Jr., A. E., and D. R. Cook. The Collector's Library, Part II. Minerals of the United States. Mineral. Rec., v. 10, No. 1, January-February 1979, pp. 13-28.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Gypsum:			
Georgia Pacific Corp	Sigurd, UT 84657	Open pit mine and plant	Sevier.
United States Gypsum Co	Box 128 Sigurd, UT 84657	Quarry and plant	Do.
Iron ore:			
CF&I Steel Corp	Box 100 Cedar City, UT 84720	Open pit mines	Iron.
United States Steel Corp	Box 851 Cedar City, UT 84720	do	Do.
Utah International, Inc	Box 649 Cedar City, UT 84720	Open pit mines and plants	Do.
Lead:			
United Park City Mines Co.[4]	309 Kearns Bldg. Salt Lake City, UT 84101	Underground mine and plant	Summit.
Lime:			
The Flintkote Co.[1]	Box 357 Grantsville, UT 84029	Open pit mine and plant	Tooele.
Utah Marblehead Lime Co	Box 268 Tooele, UT 84074	do	Do.
Magnesium:			
NL Industries, Inc	238 North 2200 West Salt Lake City, UT 84116	Plant	Do.
Phosphate rock:			
Stauffer Chemical Co	Manila Star Route Vernal, UT 84078	Underground mine and plant	Rich, Salt Lake, Uintah.
Potassium salts:			
Great Salt Lake Minerals and Chemical Corp.[5]	765 North 10500 West Box 1190 Ogden, UT 84402	Plant	Box Elder.
Kaiser Aluminum & Chemical Corp.[6]	Box 580 Wendover, UT 84083	do	Tooele.
Texasgulf, Inc	Box 1208 Moab, UT 84532	Underground mine and plant	Grand.
Salt:			
American Salt Co	Box 477 Grantsville, UT 84029	Plant	Tooele.
Morton Salt Co	A.M.F. Box 22054 Salt Lake City, UT 84122	do	Salt Lake.
Sand and gravel:			
Cox Enterprises, Inc	50 East First North Manti, UT 84642	Pits	Sanpete.
Gibbons & Reed Co	825 West 1000 North Box 30429 Salt Lake City, UT 84116	Pits and plants	Davis, Salt Lake, Weber.
Monroc Sand & Gravel	1730 Beck St. Box 537 Salt Lake City, UT 84116	do	Salt Lake.
Parson Ready-Mix Co., Inc	33 South 900 East Box 517 Brigham City, UT 84302	do	Box Elder, Cache, Davis.
Stone:			
Southern Pacific Transportation Co	401 I St. Sacramento, CA 95814	Quarry	Box Elder.
United States Steel Corp., Western Stone Operations.	Box 510 Provo, UT 84601	do	Utah.
Uranium-vanadium:			
Atlas Minerals Div. of Atlas Corp.	Box 1207 Moab, UT 84532	Underground mines and plant	Emery, Grand, San Juan.
Energy Fuels Nuclear, Inc	Box 59 Blanding, UT 84511	Ore buying station and mill	San Juan.
Rio Algom Corp	Box 610 Moab, UT 84532	Underground mine and plant	Do.
Union Carbide Mining and Metals.	Box 1029 Grand Junction, CO 81501	Underground mines	Grand and San Juan.

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[1] Also stone.
[2] Also gold, lead, lime, molybdenum, selenium, stone, silver, and zinc.
[3] Also gold and silver.
[4] Also copper, gold, silver, and zinc.
[5] Also magnesium compounds and salt.
[6] Also magnesium compounds.

The Mineral Industry of Vermont

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Office of the State Geologist, Agency of Environmental Conservation, for collecting information on all nonfuel minerals.

By Doss H. White, Jr.[1] and Charles A. Ratté[2]

Nonfuel mineral production in 1978 and 1979 added $47.8 million and $54.1 million, respectively, to the economy of Vermont. The State led the Nation in the production of talc, and ranked second in asbestos, dimension granite, dimension marble, and dimension slate. Mineral production was reported from all 14 counties. Dimension stone, crushed stone, and sand and gravel accounted for over 80% of mineral value during the biennium.

Trends and Developments.—Approximately 7% of the State's industrial workers were engaged in mineral extraction or in an industry relying heavily on mineral raw materials. However, in specific localities, employment in mineral production or processing was significant. In Barre, Washington County, 80% of the manufacturing firms produced stone (primarily granite monuments), clay, or glass products, and in Rutland County almost 20% of all firms mined, processed, or finished slate or marble. Granite working and finishing accounted for approximately 50% of manufacturing in Washington County.

Legislation and Government Programs.—A bill introduced by the Vermont Legislature, H.327, would require an Act 250 (Vermont's Development Control Law) permit for mineral prospecting and exploration beyond the reconnaissance level. The bill was the culmination of a West German firm's efforts to explore for, and possibly

Table 1.—Nonfuel mineral production in Vermont[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Sand and gravel ___ thousand short tons __	3,405	$5,837	3,726	$6,425	3,660	$6,240
Stone:						
Crushed ________________ do ____	2,123	12,635	1,971	13,178	2,077	13,927
Dimension ______________ do ____	121	14,561	137	17,681	180	23,006
Talc ____________________ do ____	310	2,006	315	2,238	346	2,755
Combined value of other nonmetals ______	XX	6,415	XX	8,311	XX	8,208
Total ______________________	XX	41,454	XX	47,833	XX	54,136

XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Vermont, by county

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Addison	W	$3,956	Stone, sand and gravel.
Bennington	$593	958	Sand and gravel, stone.
Caledonia	W	W	Stone, sand and gravel.
Chittenden	W	W	Sand and gravel, stone.
Essex	W	W	Sand and gravel.
Franklin	W	W	Stone, sand and gravel.
Grand Isle	W	W	Stone.
Lamoille	W	W	Talc, sand and gravel, stone.
Orange	990	W	Stone, sand and gravel.
Orleans	W	W	Asbestos, sand and gravel, stone.
Rutland	W	11,755	Stone, sand and gravel.
Washington	W	W	Do.
Windham	W	162	Sand and gravel, stone.
Windsor	W	W	Talc, sand and gravel, stone.
Undistributed[1]	39,869	31,003	
Total[2]	41,454	47,833	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes gem stones and values indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Vermont business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	226.0	237.0	240.0	+1.3
Unemployment do	16.0	14.0	12.0	+14.3
Employment (nonagricultural):				
Mining do	.7	.7	.8	+14.3
Manufacturing do	43.4	47.7	50.8	+6.5
Contract construction do	8.2	10.0	10.3	+0.3
Transportation and public utilities do	8.4	8.7	9.0	+3.4
Wholesale and retail trade do	36.3	39.3	40.6	+3.3
Finance, insurance, real estate do	7.0	7.5	7.7	+2.7
Services do	40.1	41.6	42.5	+2.2
Government do	34.3	35.1	35.5	+1.1
Total nonagricultural employment do	178.4	190.6	197.2	+3.5
Personal income:				
Total millions	$2,809.0	$3,214.0	$3,589.0	+11.7
Per capita	$5,827.0	$6,601.0	$7,280.0	+10.3
Construction activity:				
Number of private and public residential units authorized	2,947.0	[1]3,566.0	3,176.0	-10.9
Value of nonresidential construction millions	$11.9	$15.4	$14.7	-4.6
Value of State road contract awards do	$30.0	$27.0	$18.7	-30.7
Shipments of portland and masonry cement to and within the State thousand short tons	137.0	154.0	143.0	-7.1
Nonfuel mineral production value:				
Total crude mineral value millions	$41.5	$47.8	$54.1	+13.2
Value per capita, resident population	$86.0	$98.0	$110.0	+12.2
Value per square mile	$4,314.0	$4,978.0	$5,634.0	+13.2

[p] Preliminary.

[1] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

mine, uranium in the State. Some State officials believed that Act 250 controlled exploration and mining for all minerals. At yearend, the Act 250 Environmental Board governing body was developing rules to guide all mineral exploration in the State.

The State geologist's office was the principal agency involved in mineral-related affairs. The major function of this office during 1978-1979 was to serve as advisor-consultant to other departments and agencies of local, State, and regional government. During the period, guidelines were developed for mine reclamation; the oil and gas potential of the Champlain basin was assessed; and a number of geological mapping and mineral resource assessment studies were conducted on State lands.

The Vermont Mapping Advisory Committee and the cooperative mapping program between the State and the U.S. Geological Survey were reestablished. The State geologist chairs the Mapping Advisory Committee.

Vermont continued cooperative programs with the Federal Bureau of Mines to research the use of mine tailings as mineral raw materials. Vermont slate, marble, and asbestos tailings were under investigation. Initial results were favorable for producing insulation from the slate and marble wastes, and a synthetic highway aggregate was produced from asbestos mine tailings.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Asbestos.—Vermont Industrial Products, a subsidiary of Vermont Asbestos Group, Inc., mined asbestos from surface operations near Lowell. Output was used in asbestos cement products.

Cement.—All cement used by the construction industry during the biennium was imported. Vermont and the other New England States, excluding Maine, have no cement-producing plants. Shipments to the State in 1978 totaled 148,000 tons of portland and 6,000 tons of masonry; 1979 shipments were 138,000 tons of portland and 5,000 tons of masonry.

Mica.—Crude mica, imported from foreign sources by the U.S. Samica Corp., Rutland, was used in the manufacture of mica paper for electrical insulation.

Sand and Gravel.—Construction sand and gravel was the second leading commodity in terms of tonnage and value during the biennium. In 1979, 43 companies produced sand and gravel from 45 deposits, a decrease of 6 companies and 6 deposits from the previous year. Leading counties in tonnage were Chittenden, in the northwestern part of the State, and Bennington, in the southwest. Principal end uses were roadbase, asphalt, and concrete aggregate. Other uses included fill and snow and ice control.

Officials in a number of local Vermont communities expressed concern about Federal Mine Safety and Health Administration (MSHA) regulations governing sand and gravel operations. The communities mine sand and gravel intermittently for road repair, and MSHA requires that part-time employees receive 26 hours of safety training at community expense. At the end of 1979, there were no MSHA-certified instructors in Vermont; the nearest training classes are in Pennsylvania.

Table 4.—Vermont: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	837	$1,728	$2.06	1,096	$2,366	$2.15	1,006	$2,108	$2.10
Plaster and gunite sands	NA	NA	NA	--	--	--	W	W	3.15
Concrete products	263	552	2.10	W	W	2.12	W	W	2.67
Asphaltic concrete	595	1,183	1.99	469	907	1.93	610	1,321	2.17
Roadbase and coverings	1,162	1,776	1.53	1,301	1,875	1.44	1,136	1,614	1.42
Fill	355	370	1.04	475	569	1.20	563	674	1.20
Snow and ice control	NA	NA	NA	143	228	1.59	140	221	1.57
Railroad ballast	W	W	3.31	1	2	1.13	4	10	2.80
Other uses	194	229	1.18	241	489	2.03	201	292	1.45
Total[1] or average	3,405	5,837	1.71	3,726	6,425	1.72	3,660	6,240	1.70

NA Not available. W Withheld to avoid disclosing company proprietary data, included in "Other uses."

[1] Data may not add to totals shown because of independent rounding.

Table 5.—Vermont: Construction sand and gravel sold or used by producers

	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	1,117	$1,853	$1.66	1,545	$2,692	$1.74	1,715	$3,054	$1.78
Gravel	2,288	3,984	1.74	2,181	3,734	1.71	1,945	3,186	1.64
Total or average	3,405	5,837	1.71	3,726	[1]6,425	1.72	3,660	6,240	1.70

[1] Data do not add to total shown because of independent rounding.

Stone.—During the biennium, Vermont's stone industry produced crushed limestone, granite, sandstone, marble, unspecified stone (primarily serpentine), dimension granite, marble, and slate. Although output of crushed stone increased approximately 100,000 tons in 1979, the number of quarries decreased by two-thirds. In 1978, 11 quarries crushed limstone and marble; however, no production was reported in 1979. There were 17 active producers of crushed limestone and granite in 1978, but only 11 were in operation the following year. Unspecified stone production decreased from nine quarries to two during the 2 years. Completion of highway projects was a major factor in the closing of a number of operations.

Approximately 70% of the stone produced during the biennium was crushed limestone. In 1979, output totaled 1.5 million tons, 200,000 tons over that produced during the previous year. Limestone, mined and crushed at eight operations in Addison, Crittenden, Frank, and Rutland Counties in the western part of the State, was sold for bituminous aggregate, roadbase, and whiting.

In 1979, there was no reported production of crushed marble or sandstone. However, in 1978, the Vermont State Highway Department crushed marble at two locations in Rutland County, and crushed sandstone at nine quarries in four counties in the eastern and southeastern part of Vermont. The material was used in highway construction for aggregate, roadbase, and fill.

In 1979, unspecified stone, primarily serpentine, was quarried at two locations in Lamoille and Orleans Counties in northern Vermont. Output was sold for aggregate, riprap, and jetty stone.

The crushed stone industry planned to activate three new or inactive quarries; two were opposed by local groups. OMYA, Inc., formerly Vermont Marble Co., planned to open a marble quarry near Brandon. Stone would be shipped to the company's new marble crushing facility at Florence. The company also planned to reopen an abandoned marble quarry in Florence, which was vehemently opposed by local citizens. The company has owned the mineral rights to the quarry site and surrounding acreage since 1889, and quarried stone until the early 1900's. Citizen opposition stemmed from concern over the effects of blasting on local water wells and dwellings, and of heavy truck traffic on the main road.

Another controversy arose when Pike Industries, Inc., applied for permission to open a limestone quarry on Hale Mountain near Shaftsbury to supply aggregate for 14 miles of new highway. Local residents and environmental groups opposed the plan. The Shaftsbury Zoning Board of Adjusters denied the company a zoning variance, and the company filed a $4.5 million lawsuit against the community. The suit was dropped when Shaftsbury gave the company permission to mine.

Sto Energy Conservation, Inc., a West German insulation manufacturing company, established its U.S. headquarters in Rutland. The firm will manufacture exterior building insulation from plastic foam and mesh, marble dust, and plaster. Finely ground marble from the OMYA, Inc., plant at Florence will be used in the manufacturing process.

During 1979, the State's dimension stone producers quarried 180,000 tons of stone in seven counties, an increase of approximately 43,000 tons over the previous year's output. Dimension granite accounted for approximately 62% of sales followed by 28% for slate and 10% for marble.

Dimension granite was quarried at seven locations in Orange, Orleans, Washington, and Windsor Counties in northeastern Vermont. The majority of the stone was marketed for rough monumental applications; the remainder as rough block and finished monuments. Sales in 1979 totaled $12.7 million, an increase of $1.2 million over those of 1978.

One granite producer, Rock of Ages Corp., was awarded the U.S. Department of Commerce "E" citation in recognition of "exporting excellence." The company exported about one-sixth of its total sales, primarily to Japan; this amounted to approximately 26,500 tons of granite in 1979.

Dimension slate was quarried at 16 locations in Bennington and Rutland Counties, in southwestern Vermont, in 1979. Output increased significantly over the 19,500 tons quarried in 1978. Sales of flagging and flooring slate accounted for 88% of the total. The remainder was sold for roofing tile, structural purposes, and house veneer.

One dimension slate operator filed a $1.7 million suit against the Department of Labor in Federal District Court. In 1978, a quarry wall collapsed, burying mining equipment and vehicles under tons of debris, which the operator contended was due to a Department of Labor, Mine Safety and Health Administration inspector's order to remove overburden from the quarry wall. The wall collapsed a few hours after explosives were used to move the overburden.

Table 6.—Vermont: Dimension stone[1] sold or used by producers, by use

Use	1977			1978			1979		
	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)
Rough stone:									
Rough blocks	2,574	29	$173	3,063	34	$236	W	W	W
Monumental	[r]78,339	804	8,125	94,325	961	10,843	107,546	1,094	$12,233
Dressed stone:									
House stone veneer	1,550	17	[r]319	1,550	17	219	1,452	16	317
Monumental	W	W	W	W	W	W	4,226	49	1,526
Flagging	[r]10,826	119	387	5,493	60	331	22,574	248	796
Roofing slate (standard)	1,674	18	438	2,142	24	631	4,510	50	1,396
Flooring slate	3,835	42	564	10,238	113	1,149	21,646	238	3,787
Other uses[2]	21,759	245	4,556	19,720	222	4,171	18,278	203	2,950
Total[3]	[r]120,557	1,276	[r]14,561	136,531	1,431	17,681	180,232	1,898	23,006

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes granite, marble, and slate.

[2] Includes stone used in irregular-shaped stone, rough flagging, sawed stone, roofing slate (architectural, 1979), structural and sanitary, other rough and dressed stone, and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 7.—Vermont: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate	W	W	67	217	93	304
Bituminous aggregate	539	1,482	279	902	430	1,215
Dense-graded roadbase stone	545	1,175	72	127	W	W
Other construction aggregate and roadstone	265	725	618	1,560	559	1,676
Riprap and jetty stone	28	66	25	72	13	45
Railroad ballast	W	W	99	361	W	W
Abrasives	([2])	1	---	---	---	---
Other fillers or extenders	W	W	W	W	32	W
Fill	8	16	W	W	---	---
Other uses[3]	737	9,169	810	9,938	950	10,687
Total[4]	2,123	[r]12,635	1,971	13,178	2,077	13,927

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, marble (1978), sandstone (1977-78), and other stone.

[2] Less than 1/2 unit.

[3] Includes stone used in agricultural limestone, poultry grit, and mineral food (1977); macadam aggregate (1977-78); surface treatment aggregate; filter stone (1978-79); manufactured fine aggregate (stone sand, 1978-79); terrazzo and exposed aggregate; whiting; roofing granules (1977); paper manufacture (1977); unspecified uses; and uses indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

Dimension marble was quarried at three operations in Grand Isle County in northwestern Vermont, and Rutland and Windsor Counties in the southern part of the State. Sales were principally for construction and monumental applications.

Vermont dimension stone industries were toured in September 1978 by the National Academy of Science Committee on Surface Mining and Reclamation panel. The panel evaluated the industry for possible extension of the Federal Surface Mining Control and Reclamation Act of 1977, Public Law 95-87, to surface mining of commodities other than coal.

Talc.—During the biennium, Vermont led the Nation in talc production; three companies produced over 660,000 tons valued at over $5 million. Crude talc was ground and sold for use in toiletry preparations, plastics, rubber, paper, paint, insecticides, asphalt filler, and foundry facings. Vermont Soapstone Co., Perkinsville, mined soapstone, a massive form of talc, for use as lining in wood stoves, griddles, and other heat-related products.

Vermont Talc Co. applied for an exploration permit on a 3-acre tract in Windham. Despite opposition from the Windham Planning Commission, town selectmen, and property owners, the permit was approved and the company removed samples for testing. The company was responsible for site reclamation at the termination of the 3-month permit.

METALS

Exploration for uranium and zinc highlighted metal activity in the State during 1978 and 1979.

Perhaps reflective of an attitude of some citizens of Vermont toward mining in general was the experience of Uran-Gesellschaft, USA, Inc., a West German firm that sought to explore for uranium in southern Vermont. The company leased 2,300 acres; 1,400 were near Jamaica. Other areas leased included Mount Holly, Ludlow, and Townshend. The company planned to drill the Jamaica lease in 1979, but met with opposition from the local citizens and environmental groups. After a series of meetings, marches, and rallies by the opposition, the company withdrew a request to the State for a ruling on whether Act 250, Vermont's Development Control Law, applied to uranium exploration and mining, and moved its exploration effort out of the State.

Labradex, the American subsidiary of Labrador Mining and Exploration Co., Ltd., in Toronto, Canada, purchased options on approximately 1,000 acres in Franklin County for zinc exploration. A town meeting was held and attended by local citizens, the State geologist, and company officials to explain the company's planned exploration activity and its possible effect on the community.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

[2] State geologist, Montpelier, Vt.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Asbestos:			
Vermont Asbestos Group, Inc.[1]	Box 70 Hyde Park, VT 05655	Pit	Orleans.
Sand and gravel:			
Burgess Bros., Inc	Bennington, VT 05201	Pit	Bennington.
Calkins Construction, Inc	Lyndonville, VT 05851	Pit	Orleans.
S. T. Griswold, Inc	Williston, VT 05495	Pit	Chittenden.
Hinesburg Sand and Gravel Co	Hinesburg, VT 05461	Pit	Do.
M & T Sand and Gravel Co	Swanton, VT 05488	Pit	Franklin.
Stone:			
Granite (dimension):			
Rock of Ages Corp	Barre, VT 05641	Quarries	Orange, Washington, Windsor.
Wells-Lamson Quarry Co., Inc.[2]	do	Quarry	Washington.
Limestone, dolomite, and marble (crushed, ground, and broken):			
Shelburne Limestone Corp	30 Jewett St. Shelburne, VT 05482	do	Chittenden and Franklin.
Vermarco	Proctor, VT 05765	do	Rutland.
Frank W. Whitcomb Construction Corp.	Box 429 Bellows Falls, VT 05101	do	Chittenden.

See footnotes at end of table.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Limestone, dolomite, and marble (crushed, ground, and broken) —Continued			
White Pigment Corp	Proctor, VT 05765	Quarries	Addison and Rutland.
Marble (dimension):			
Vermont Marble Co.[3]	do	do	Rutland and Windsor.
Slate (dimension):			
John G. Hadeka	Poultney, VT 05764	Quarry	Rutland.
Hilltop Slate Co	Middle Granville, NY 12849	do	Do.
Taran Bros., Inc	North Poultney, VT 05764	do	Do.
Tatko Bros. Slate Co	do	do	Do.
Vermont Structural Slate Co., Inc	Fair Haven, VT 05743	do	Do.
Talc:			
Eastern Magnesia Talc Co	Johnson, VT 05656	Underground mines.	Lamoille.
Vermont Talc, Inc	Chester, VT 05143	do	Windham.
Windsor Minerals, Inc	Windsor, VT 05089	do	Windsor.

[1] Also miscellaneous stone.

[2] Also crushed and broken granite.

[3] Also crushed and broken limestone and dolomite.

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The Mineral Industry of Virginia

By Leonard J. Prosser[1]

The value of Virginia's nonfuel mineral production was $264.9 million in 1978 and $309.8 million in 1979. During these years, Virginia's major nonfuel commodities were, in terms of value, cement, kyanite, lime, sand and gravel, stone, and zinc. Other commodities that contributed to the State's mineral economy included aplite, clay, gypsum, lead, and talc. Also, the State's first vermiculite mine began production in 1979.

Trends and Developments.—In the 1970's, stone production accounted for approximately 50% of Virginia's total nonfuel mineral production value. Stone output peaked in 1978 at 50.5 million short tons and again in 1979 at 51.1 million short tons. As these record production levels were reached, the State's nonfuel mineral production value surpassed the $300 million mark for the first time.

Virginia became the third State in the Nation to produce crude vermiculite when Virginia Vermiculite, Ltd., began operations in 1979. The open pit operation is located about 20 miles east of Charlottesville in Louisa County. Previously, Montana and South Carolina accounted for all domestic vermiculite production. The material, after extraction, is exfoliated and used mostly by the construction industry.

Table 1.—Nonfuel mineral production in Virginia[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	890	$1,294	1,043	$3,266	1,059	$3,512
Gem stones	NA	12	NA	15	NA	15
Lead (recoverable content of ores, etc.) metric tons	1,999	1,352	1,803	1,339	1,596	1,852
Lime thousand short tons	846	28,767	832	30,578	872	34,935
Sand and gravel[2] do	10,447	24,605	11,430	29,070	11,803	32,268
Stone:						
Crushed do	41,707	109,737	50,442	141,601	51,080	165,223
Dimension do	10	1,864	10	1,943	9	2,042
Zinc (recoverable content of ores, etc.) metric tons	12,040	9,131	10,974	7,500	11,406	9,380
Combined value of aplite, cement, gypsum, kyanite, sand and gravel (industrial), silver (1977), talc (soapstone), and vermiculite (1979)	XX	39,104	XX	49,585	XX	60,538
Total	XX	215,866	XX	264,897	XX	309,765

NA Not available. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Virginia, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Accomack	$163	$273	Sand and gravel.
Albemarle	W	W	Stone, sand and gravel.
Alleghany	W	W	Stone.
Amherst	W	W	Stone, sand and gravel.
Appomattox	W	W	Stone.
Augusta	W	W	Stone, sand and gravel.
Bedford	W	W	Stone.
Bland	W	W	Do.
Botetourt	W	W	Cement, stone, clays.
Brunswick	W	W	Stone, clays.
Buckingham	W	W	Kyanite, stone.
Campbell	2,830	3,678	Stone, sand and gravel.
Caroline	753	953	Sand and gravel.
Charles City	W	W	Do.
Charlottesville (city)[2]	W	--	
Chesapeake (city)	W	W	Cement, sand and gravel.
Chesterfield	W	W	Sand and gravel, stone, clays.
Clarke	W	W	Stone.
Craig	175	175	Sand and gravel.
Culpeper	W	W	Stone.
Dinwiddie	W	W	Do.
Fairfax	W	W	Stone, sand and gravel.
Fauquier	1,857	W	Stone.
Floyd	W	8	Do.
Franklin	W	W	Stone, soapstone.
Frederick	W	W	Stone, lime.
Giles	W	W	Lime, stone.
Gloucester	36	27	Sand and gravel.
Goochland	3,584	5,753	Stone.
Grayson	W	W	Stone, sand and gravel.
Greensville	W	W	Stone, clays.
Halifax	W	W	Stone, sand and gravel.
Hanover	W	W	Stone, aplite, sand and gravel.
Henrico	10,746	11,990	Sand and gravel, stone.
Henry	1,704	W	Stone, sand and gravel.
Highland	W	W	Stone.
Isle of Wight	W	67	Sand and gravel.
James City	--	W	Do.
King George	W	W	Do.
King William	W	33	Do.
Lancaster	24	44	Do.
Lee	W	W	Stone.
Loudoun	7,656	11,000	Do.
Middlesex	11	W	Sand and gravel.
Montgomery	W	W	Stone, clays.
Nansemond	W	W	Sand and gravel.
Nelson	W	W	Stone, aplite.
New Kent	225	W	Sand and gravel.
Newport News (city)	W	W	Do.
Northampton	W	27	Do.
Northumberland	18	18	Do.
Nottoway	1,651	W	Stone.
Orange	W	W	Clays.
Page	W	W	Stone.
Pittsylvania	W	W	Stone, sand and gravel.
Powhatan	W	W	Stone.
Prince Edward	W	W	Kyanite, stone.
Prince George	W	W	Sand and gravel.
Prince William	W	W	Stone, clays.
Pulaski	W	W	Stone.
Rappahannock	W	W	Do.
Richmond (city)	W	W	Stone, clays.
Roanoke	W	5,031	Do.
Rockbridge	W	W	Do.
Rockingham	W	W	Stone, sand and gravel.
Russell	5,808	6,937	Stone.
Scott	2,091	1,686	Do.
Shenandoah	W	W	Lime, stone.
Smyth	W	W	Stone, clays, sand and gravel.
Southampton	175	175	Sand and gravel.
Spotsylvania	W	W	Stone, sand and gravel.
Stafford	W	W	Sand and gravel, stone.
Suffolk (city)	W	W	Sand and gravel.
Surry	W	W	Do.
Tazewell	W	W	Stone, clays.
Virginia Beach (city)	2,074	2,035	Sand and gravel.
Warren	W	W	Cement, lime, stone, sand and gravel.
Washington	W	W	Stone, gypsum.
Westmoreland	92	89	Sand and gravel.
Wise	W	1,566	Stone.

See footnotes at end of table.

Table 2.—Value of nonfuel mineral production in Virginia, by county[1] —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Wythe	$15,777	$14,175	Zinc, stone, lead.
York	W	91	Sand and gravel.
Undistributed[2]	158,413	199,067	
Total[3]	215,866	264,897	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] The following cities and counties are not listed because no production was reported: Alexandria (city), Amelia, Arlington, Bath, Bedford (city), Bristol (city), Buchanan, Buena Vista (city), Carroll, Charlotte, Clifton Forge (city), Colonial Heights (city), Covington (city), Cumberland, Danville (city), Dickenson, Emporia (city), Essex, Fairfax (city), Falls Church (city), Fluvanna, Franklin (city), Fredericksburg (city), Galax (city), Greene, Hampton (city), Harrisonburg (city), Hopewell (city), King and Queen, Lexington (city), Louisa, Lunenburg, Lynchburg (city), Madison, Martinsville (city), Mathews, Mecklenburg, Norfolk (city), Norton (city), Patrick, Petersburg (city), Portsmouth (city), Radford (city), Richmond, Roanoke (city), Salem (city), South Boston (city),Staunton(city), Sussex, Waynesboro (city), Williamsburg (city), and Winchester (city).

[2] Includes gem stones and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Virginia business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	2,363.0	2,443.0	2,477.0	+1.4
Unemployment	do.	126.0	131.0	117.0	-10.7
Employment (nonagricultural):					
Mining[1]	do.	22.0	20.5	24.2	+18.0
Manufacturing	do.	400.8	409.4	413.1	+.9
Contract construction	do.	119.0	130.2	135.4	+4.0
Transportation and public utilities	do.	105.9	107.6	114.3	+6.2
Wholesale and retail trade	do.	405.6	428.1	439.9	+2.8
Finance, insurance, real estate	do.	91.7	97.1	103.3	+6.4
Services	do.	331.8	357.9	374.6	+4.7
Government	do.	453.6	482.7	493.6	+2.3
Total nonagricultural employment[1]	do.	1,930.4	2,033.5	2,098.4	+3.2
Personal income:					
Total	millions	$35,418	$39,746	$44,719	+12.5
Per capita		$6,952	$7,721	$8,605	+11.4
Construction activity:					
Number of private and public residential units authorized		54,946	[2]51,970	45,333	-12.8
Value of nonresidential construction	millions	$521.3	$826.1	$1,032.9	+25.0
Value of State road contract awards	do.	$294.0	$360.0	$243.0	-32.5
Shipments of portland and masonry cement to and within the State	thousand short tons	1,829	2,111	2,164	+2.5
Nonfuel mineral production value:					
Total crude mineral value	millions	$215.9	$264.9	$309.8	+16.9
Value per capita, resident population		$42	$51	$60	+17.6
Value per square mile		$5,289	$6,490	$7,589	+16.9

[p] Preliminary.

[1] Includes bituminous coal, oil, and gas extraction.

[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

Legislation and Government Programs.—In 1979, Virginia's General Assembly established a study commission to examine the State's port facilities and recommend improvements. Virginia's port complex includes Hampton Roads, one of the world's finest harbors, where freight traffic annually exceeds 50 million tons, plus three inland river ports. Both foreign and domestic cargoes were handled at Hampton Roads, and approximately 3.75 million tons of the port's annual freight traffic in 1978 and 1979 was directly or indirectly related to the nonfuel mineral industry. Imports in 1978 and 1979 included manganese, iron ore, ferroalloys, limestone, and other nonmetallic minerals. Mineral exports were nonferrous metals and ores, clay, sand and gravel, and crushed stone.

The State Water Control Board, in cooperation with the U.S. Environmental Protection Agency, continued reclamation

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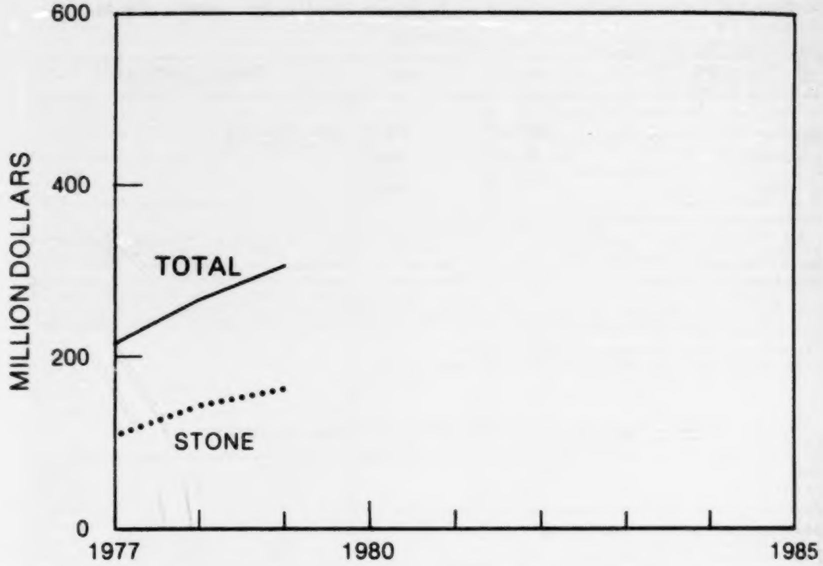

Figure 1.—Value of stone and total value of all nonfuel mineral production in Virginia.

work along Contrary Creek in Louisa County in 1978 and 1979. The project, started in 1976, was aimed at controlling high concentrations of dissolved metals from three inactive pyrite mines. Low rainfall and the general toxicity of the land around the mine sites hampered efforts, but 19.5 acres was reclaimed at two sites near the town of Mineral.

The Federal Office of Coastal Zone Management terminated support of Virginia's Coastal Resources Management Program in 1979. By law, the Federal Government allocates 80% of the funds for a State's coastal resources planning and management, provided the State develops a program that meets Federal guidelines. Although Virginia's program met the required Federal guidelines, it was not approved by the General Assembly. Opponents within the State believed that it would have restricted industrial development, including mineral extraction, in coastal areas.

In 1978 and 1979, the Virginia Department of Conservation and Development's Division of Mineral Resources continued mineral resource evaluations, as well as geologic and topographic mapping programs. Geologic maps of nine quadrangles were published. Work began on a study of the geology and mineral resources of two quadrangles in the central Piedmont Province, under an agreement with the Piedmont Planning District Commission.

The Federal Bureau of Mines and the U.S. Geological Survey (USGS), in accordance with provisions of the Wilderness Act, conduct mineral surveys of lands considered for addition to the National Wilderness Preservation System. Results of mineral surveys are published by the USGS in a bulletin series. A report on the mineral resources of the Mill Creek, Mountain Lake, and Peter Mountain wilderness study areas was released as USGS Open File Report 78-1076 in 1978. The report listed iron ores and common building stone as possible prospects for mineral development, but neither appeared commercially attractive under then-current market conditions.

The Forest Service of the U.S. Department of Agriculture instituted the Roadless Area Review and Evaluation (RARE II) program in 1977. The program identified roadless and undeveloped land areas in the National Forest System to determine their general use for wilderness or other multiple use designation resource development. In 1978, the Forest Service identified 16 areas in Jefferson National Forest, 7 of which, totaling 29,553 acres, were recommended to Congress for addition to the Wilderness System. Of the 15 areas identified in George Washington National Forest, 5, totaling 33,025 acres, were nominated for wilderness designation. Congressional action on the 12 areas was expected in 1980. Once an area is designated as wilderness by Congress, virtually all activities that could alter the natural character of the land are prohibited.

Virginia's Division of Mined Land Reclamation received a $203,000 grant in 1979 from the U.S. Office of Surface Mining. The funds were to be used to inventory the State's abandoned mine lands as a first step towards reclamation. The Division's Minerals Other Than Coal Section reported that in the 1978-79 period, the State's clay, sand and gravel, and stone mining operations disturbed 2,068 acres, and only 334 were reclaimed.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Aplite.—Virginia was the only State to produce aplite in 1978 and 1979. The Feldspar Corp., Hanover County, and International Minerals and Chemical Corp., Nelson County, mined aplite by open pit methods. After onsite processing, aplite was used primarily in the manufacture of glass. In 1978, Owens-Illinois, Inc., began construction of a glass container plant in James City that was being designed to use aplite, along with other materials, to make throwaway bottles. The plant was scheduled to begin production in early 1980 with an estimated annual output of 500 million glass containers.

Cement.—Lone Star Cement, Inc., Botetourt County, and Riverton Corp., Warren County, produced cement in the State in 1978 and 1979. One of the Nation's largest operators, Lone Star Cement, Inc., produced both portland and masonry cement at its Botetourt plant, which has an annual capacity of over 1 million tons. The company also operated cement manufacturing plants in the city of Chesapeake. Riverton Corp. produced only masonry cement.

Clays.—In 1978 and 1979, clay was produced by 8 companies in 11 counties and 1 city. Leading counties, in decreasing order of production tonnage, were Botetourt, Smyth, Orange, and Brunswick. During this period, nine plants used clay in brick production. A 10th brick plant was under development in 1979, with capacity estimated at 35 million brick annually. About 90% of the clay produced in Virginia was used in the manufacture of face and common brick. The manufacture of lightweight aggregate for use in concrete block and structural concrete accounted for the remainder.

Table 4.—Virginia: Clays sold or used by producers

(Thousand short tons and thousand dollars)

Year	Quantity	Value
1975	819	1,152
1976	862	1,210
1977	890	1,294
1978	1,043	3,266
1979	1,059	3,512

Gypsum.—United States Gypsum Co., Virginia's only producer of crude gypsum in 1978 and 1979, continued underground mining operations at the Plasterco mine in Washington County. Gypsum was processed at the company's mill in Plasterco for use in gypsum wallboard, portland cement, and as agricultural gypsum. The company also operated a mill in Norfolk to process material imported from Nova Scotia, Canada.

Kyanite.—Virginia led the Nation in kyanite production in 1978 and again in 1979. Kyanite Mining Corp. operated one surface mine at Willis Mountain, Buckingham County, and another at Baker Mountain, Prince Edward County. Most of the ore was processed at plants near the mine sites and converted to synthetic mullite by calcination. The finished product was marketed in bulk or in bags. The major use of kyanite was in the manufacture of brick for rotary kilns and furnaces.

Lime.—In terms of value, lime was among the State's leading nonfuel commodities in 1978 and 1979. Lime was produced by six companies with operations in Frederick, Giles, Shenandoah, and Warren Counties. Consumption was mainly by the paper and pulp and steel industries.

Mica.—Two plants in the Newport News area processed imported mica. Asheville Mica Co. operated a fabricating plant, and the Mica Co. of Canada, Inc., operated a plate-mica plant.

Perlite.—Johns-Manville Sales Corp., Shenandoah County, imported crude perlite from New Mexico. The product was expanded and used in the manufacture of roof insulation board.

Sand and Gravel.—In the 1970's, Virginia's sand and gravel industry contributed about 13% of the State's total nonfuel mineral value. Production in 1979 was by 84 companies at 90 locations. Of the State's 90 operations, 75 produced less than 200,000 tons each. Of those operations with greater output, eight produced between 200,000 and 500,000 tons; five produced between 500,000 and 900,000 tons; and two produced between 1 million and 1.5 million tons together. The 15 operations accounted for about 75% of the State total. Of the State's 42 counties that produce sand and gravel, Henrico led with an annual output of about 3.6 million short tons.

Most of the State's sand and gravel was used by the construction industry in concrete aggregate and concrete products. Industrial sand was produced by J. C. Jones Sand Co., Inc., Virginia Beach, for use in casting applications and as a traction medium.

Efforts continued to reclaim lands affected by sand and gravel extraction. Operations in 1978 disturbed 487 acres, and 79 acres were reclaimed; in 1979, 442 acres were disturbed, and 120 acres were reclaimed.

Table 5.—Virginia: Lime sold or used by producers, by use

Use	1977		1978		1979	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Steel, BOF	359,000	$12,168	281,500	$10,358	273,635	$10,960
Paper and pulp	128,500	4,354	201,400	7,409	207,135	8,297
Water purification	110,100	3,730	86,400	3,180	94,107	3,769
Acid mine water	W	W	38,649	1,422	69,967	2,802
Steel, electric	54,970	1,863	58,200	2,146	57,565	2,310
Steel, open-hearth	52,590	1,782	W	W	51,084	2,046
Mason's lime	43,430	1,742	40,400	1,433	W	W
Sewage treatment	48,120	1,631	26,900	990	25,648	1,027
Agriculture	7,250	274	5,930	248	6,169	247
Other uses[1]	41,770	1,221	92,500	3,392	86,783	3,477
Total[2]	845,700	28,767	831,900	30,578	872,193	34,935

W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes construction lime (1979), fertilizer (1978-79), finishing lime (1977), food and food byproducts (1978-79), glass, other chemical and industrial uses, other construction uses (1978), other metallurgical uses, petroleum refining (1978-79), soil stabilization, sugar refining, tanning, wire drawing (1978), and uses indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Table 6.—Virginia: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	3,984	$10,806	$2.71	5,310	$14,183	$2.67	4,738	$14,671	$3.10
Plaster and gunite sands	NA	NA	NA	167	487	2.91	125	501	4.02
Concrete products	1,918	5,680	2.96	1,549	5,370	3.47	1,632	6,118	3.75
Asphaltic concrete	1,997	3,521	1.76	771	1,595	2.07	676	1,745	2.58
Roadbase and coverings	790	2,055	2.60	1,531	4,083	2.67	1,402	4,205	3.00
Fill	1,409	1,755	1.25	1,479	1,965	1.33	2,423	3,003	1.24
Snow and ice control	NA	NA	NA	66	137	2.07	66	138	2.09
Other uses	349	788	2.26	553	1,252	2.27	741	1,886	2.54
Total[1] or average	10,447	24,605	2.36	11,430	29,070	2.54	11,803	32,268	2.73

NA Not available.

[1] Data may not add to totals shown because of independent rounding.

Table 7.—Virginia: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	6,772	14,167	$2.09	7,752	17,518	$2.26	8,091	18,638	$2.30
Gravel	3,675	10,438	2.84	3,675	11,555	3.14	3,712	13,629	3.67
Total or average	10,447	24,605	2.36	11,430	29,070	2.54	11,803	[1]32,268	2.73
Industrial sand	W	W	3.37	W	W	5.24	W	W	6.71
Grand total or average	W	W	2.36	W	W	2.56	W	W	2.75

W Withheld to avoid disclosing company proprietary data.

[1] Data do not add to total shown because of independent rounding.

Stone.—In terms of value and quantity, stone was Virginia's leading nonfuel mineral commodity throughout the 1970's. Nationally, the State ranked sixth in total stone production and fifth in the value of stone production in 1978 and maintained the same position in 1979. During this period, granite, limestone, marl, sandstone, traprock, and slate were extracted at 130 quarries. Output at each of 16 quarries exceeded 900,000 short tons and accounted for 39% of the total State production. Leading counties, in decreasing order of production tonnage, were Loudoun, Goochland, Fairfax, Dinwiddie, and Wythe.

About 99% of the stone produced in Virginia was marketed as crushed stone. The construction industry remained the State's primary consumer, utilizing crushed stone as roadbase and concrete aggregate. Crushed limestone production averaged about 24 million short tons annually in 1978 and 1979, and most of it was used in construction. High-calcium limestone was used in the manufacture of lime and cement and as a raw material in the steel, glass, and chemical industries.

Table 8.—Virginia: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	1,660	6,880	1,620	7,612	1,710	8,361
Agricultural marl and other soil conditioners	6	13	4	8	W	10
Concrete aggregate	[r]4,786	[r]12,437	4,163	11,896	4,339	14,033
Bituminous aggregate	5,270	14,171	4,913	13,720	4,818	16,818
Macadam aggregate	531	1,237	428	1,065	438	1,309
Dense-graded roadbase stone	16,036	39,013	20,806	54,978	19,647	61,581
Surface treatment aggregate	2,116	5,789	4,086	12,192	3,417	11,968
Other construction aggregate and roadstone	5,689	13,937	7,346	19,159	9,078	27,219
Riprap and jetty stone	208	677	271	1,004	298	1,225
Railroad ballast	288	664	458	1,183	442	1,285
Filter stone	W	W	97	269	472	984
Manufactured fine aggregate (stone sand)	574	1,882	914	3,421	1,229	4,222
Cement manufacture	1,584	2,979	1,609	2,588	1,649	2,752
Lime manufacture	1,566	2,977	1,723	4,042	1,607	3,918
Flux stone	207	435	222	488	201	504
Mine dusting	442	1,656	440	1,784	331	2,079
Other fillers or extenders	168	963	150	921	139	963
Other uses[2]	575	4,026	1,191	5,270	1,265	5,993
Total[3]	41,707	109,737	50,442	141,601	51,080	165,223

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, marl, marble (1977), sandstone, shell (1977), traprock, other stone, and slate.

[2] Includes stone used in poultry grit and mineral food, ferrosilicon (1978-79), asphalt filler, glass manufacture, roofing granules (1979), terrazzo and exposed aggregate (1977), slate floor (1977-78), lightweight aggregate, sulfur dioxide (1979), unspecified uses, and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Limestone, granite, sandstone, and slate were quarried for dimension stone at nine sites located primarily in central Virginia. Slate was the principal type of dimension stone quarried and was used for roofing material.

Sulfur.—Hydrogen sulfide gas was converted to elemental sulfur by the Amoco Oil Co. at its Yorktown refinery in York County. The hydrogen sulfide gas was burned, with approximately 33% of the hydrogen sulfide oxidizing to sulfur dioxide. (These two gases react to produce elemental sulfur.)

Talc.—Blue Ridge Talc Co., Inc., Franklin County, produced small quantities of talc from intermittent surface mining operations. The material was processed at a nearby plant and marketed for use in refractories.

Vermiculite.—Virginia Vermiculite, Ltd., in Louisa County, began limited production in 1979. The vermiculite was extracted by open pit mining and processed at a nearby mill. Coarse grades of expanded vermiculite are used for loosefill insulation in homes and other structures; finer grades are used in numerous agricultural and chemical applications.

METALS

Ferroalloys.—Chemstone Corp. produced ferrovanadium at its Strasburg plant in Shenandoah County for use as a toughening ingredient in steelmaking.

Iron Oxide Pigments.—Virginia was one of four States in the country that produced crude iron oxide pigments in 1978 and 1979. Hoover Color Corp., the State's only producer, recovered brown iron oxides from a surface mining operation in Pulaski County. The company used the material to produce natural — and mixtures of natural and synthetic — iron oxide pigments. Blue Ridge Talc Co., Inc., which operated a processing plant in Henry County, purchased crude iron oxide to produce mixtures of natural and synthetic pigments. Iron oxide pigments were used in printing inks, paint manufacturing, and as coloring agents in other products.

Table 9.—Virginia: Mine production of recoverable lead and zinc

Year	Lead		Zinc	
	Quantity (metric tons)	Value[1] (thousands)	Quantity (metric tons)	Value[2] (thousands)
1975	2,316	$1,097	13,754	$11,818
1976	1,767	899	10,205	8,319
1977	1,999	1,352	12,040	9,131
1978	1,803	1,339	10,974	7,500
1979	1,596	1,852	11,406	9,380

[1] U.S. producers' prices.
[2] Prime western and high grade.

Lead and Zinc.—The State's only production of lead and zinc was from Wythe County, where one company operated an underground mine. The mine was the State's only active metal mine in 1978 and 1979. All haulage was by rail to an underground crusher. The crushed ore was hoisted to the surface, where it was processed in a flotation mill. Mill output included concentrates of zinc and lead sulfides and finely ground dolomitic limestone.

Lithium.—Foote Mineral Co., Scott County, processed lithium carbonate mined in North Carolina and Nevada to produce lithium hydroxide. The product was used in the manufacture of multipurpose grease. Foote began processing operations in Virginia in 1953 and is one of the major lithium producers in the United States.

Manganese.—Union Carbide Corp.'s Battery Products Div. near Newport News operated a processing plant for imported manganese. The product was used primarily in the manufacture of batteries.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

Table 10.—Principal producers

Commodity and company	Address	Type of activity	County
Aplite (crude):			
The Feldspar Corp	Route 1, Box 23 Montpelier, VA 23192	Quarry and plant	Hanover.
International Minerals & Chemical Corp.	Box 38 Piney River, VA 22964	do	Nelson.
Cement:			
Lone Star Cement, Inc.[1]	Box 27 Cloverdale, VA 24077	do	Botetourt.
Lone Star Cement, Inc	Box 5128 Chesapeake, VA 23320	Plant	Chesapeake (city).
Riverton Corp.[2]	Riverton, VA 22651	Quarry and plant	Warreh.
Clay and shale:			
Brick and Tile Corp	Box 45 Lawrenceville, VA 23868	Pits and plant	Brunswick and Greensville.
General Shale Products Corp	Box 3547 Johnson City, TN 37601	do	Rockbridge, Smyth, Tazewell.
Weblite Corp	Box 12867 Roanoke, VA 24029	do	Botetourt.
Webster Brick Co., Inc	do	do	Botetourt and Orange.
Ferroalloys:			
Chemstone Corp.[3]	Box 189 Strasburg, VA 22657	Plant	Shenandoah.
Gypsum:			
United States Gypsum Co	Box 4686 Norfolk, VA 23523	do	Norfolk (city).
Do	Route 1 Saltville, VA 24370	Mine and plant	Washington.
Iron oxide pigments (crude):			
Hoover Color Corp	Box 218 Hiwassee, VA 24347	do	Pulaski.
Kyanite:			
Kyanite Mining Corp	Dillwyn, VA 23936	do	Buckingham and Prince Edward.
Lime:			
Chemstone Corp.[4]	Box 71 Strasburg, VA 22657	Plant	Shenandoah.
W. S. Frey Co., Inc	Box 65 Clearbrook, VA 22657	do	Frederick.
The Flintkote Stone Products Co	Box 8 Stephens City, VA 22655	do	Do.
National Gypsum Co	Star Route 635 Ripplemead, VA 24150	do	Giles.
Virginia Lime Co	Star Route Ripplemead, VA 24150	do	Do.
Perlite, expanded:			
Johns-Manville Sales Corp	Box 442 Woodstock, VA 22644	do	Shenandoah.
Sand and gravel:			
Fredericksburg Sand and Gravel Co	Box 650 Culpeper, VA 22701	Pits	Stafford.
Lone Star Industries, Inc	Box 34527 Richmond, VA 23229	Pits and plant	Charles City, Chesterfield, Henrico, Prince George.
Sadler Materials Corp	Box 5607 Virginia Beach, VA 23455	Pits	Prince George and Henrico.
Solite Corp	Box 883 Fredericksburg, VA 22401	do	King George.
West Sand and Gravel Co., Inc	Box 6008 Richmond, VA 23222	do	Henrico.
E. V. Williams Co., Inc	Box 938 Norfolk, VA 23501	do	Virginia Beach (city).
Stone:			
Chantilly Crushed Stone, Inc	Box 112 Chantilly, VA 22021	Quarries	Loudoun.
Culpeper Stone Co., Inc	Box 650 Culpeper, VA 22701	do	Culpeper.
Lone Star Industries, Inc	977 Norfolk Square Norfolk, VA 23501	do	Brunswick, Chesterfield, Dinwiddie.
Luck Quarrys, Inc	Box 4682 Richmond, VA 23229	do	Albemarle, Augusta, Fairfax, Goochland, Halifax, Mecklenburg, Pittsylvania, Prince William, Rockingham, Washington.

See footnotes at end of table.

Table 10.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone —Continued			
Vulcan Materials Co., Midsouth Div	Drawer 920 Bristol, VA 24200	Quarries	Bristol.
Talc:			
Blue Ridge Talc Co., Inc.[5]	Box 59 Henry, VA 24102	Quarry and plant	Franklin.

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[1] Also sand and gravel and stone.
[2] Masonry cement only; also produces limestone and lime.
[3] Also lime.
[4] Also ferroalloys.
[5] Also finished oxide pigments.

The Mineral Industry of Washington

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Washington Division of Geology and Earth Resources for collecting information on all nonfuel minerals.

By George T. Krempasky[1]

The value of nonfuel mineral production in Washington was $180 million in 1978 and $225 million in 1979. The nonmetals—cement, clays, gem stones, diatomite, gypsum, lime, olivine, peat, pumice, sand and gravel, stone, sulfur, and talc—accounted for more than 70% of the total output value. The metals—copper, gold, lead, silver, and tungsten—accounted for the remainder.

With seven aluminum reduction plants, Washington was the leading State in primary aluminum production. Raw material used in the production of aluminum was imported, largely from Australia.

Exploration and development continued in the State to increase the resource reserve base of known mineral commodities. At Republic, gold-mining operations of Day Mines, Inc., have resumed. Continued exploration at Mt. Tolman has shown a richer copper-molybdenum deposit than originally thought. Production of nonmetals, especially construction materials, continued at relatively high rates. Cement was manufactured at four plants, most counties produced sand and gravel, and various counties produced stone. Clays were produced in eight counties; diatomite in Grant County, olivine in Skagit and Whatcom Counties, and talc and soapstone in Skagit County.

Trends and Developments.—Historically, Washington has not been a large mineral producer. However, the Department of Natural Resources plans to carry out a legislative mandate to encourage investment by the mining industry. The department is developing a program to update and expand its knowledge of the State's mineral resource base; the intent is to include economic analyses and projections indicating at what price resources will become economic. Projections are expected to include adoption of new techniques for mining and processing as well as projected supply and demand. In addition, the studies are intended to include environmental impact analysis to determine how adverse impacts can be mitigated.

During the period 1978-79, the Secretary of the Interior designated 31 schools and universities, including the University of Washington in Seattle, as State Mining and Mineral Resources and Research Institutes under Title III of Public Law 95-87.

The act provides for annual allotments to one designated institute in each participating State through fiscal year 1984; it also provides for research and scholarship grants to each institute. The institutes are to establish training programs in mining and minerals extraction, and to provide scholarships and fellowships. Each institute initially received a basic grant of $110,000, and $160,000 for scholarships and fellowships.

The Washington Department of Ecology

Table 1.—Nonfuel mineral production in Washington[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:						
Masonry thousand short tons	W	W	W	W	10	$741
Portland do	1,462	$65,281	1,760	$86,671	1,761	98,659
Clays[2] do	309	1,091	357	1,418	339	1,549
Gem stones	NA	100	NA	170	NA	170
Gold troy ounces	24,006	3,560	W	W	W	W
Lead (recoverable content of ores, etc.) metric tons	1,090	738	W	W	W	W
Peat thousand short tons	12	117	10	124	11	148
Pumice do	W	W	50	63	--	--
Sand and gravel do	18,505	39,124	[3]22,150	[3]49,440	[3]24,258	[3]59,382
Silver thousand troy ounces	121	567	W	W	W	W
Stone:						
Crushed thousand short tons	12,239	28,156	9,789	22,059	15,192	35,783
Dimension do	5	440	5	454	4	268
Zinc metric tons	5,055	3,834	W	W	--	--
Combined value of clays (fire clay), copper, diatomite, gypsum, lime, olivine, sand and gravel (industrial, 1978-79), talc (1977-78), tungsten, and values indicated by symbol W	XX	9,829	XX	20,034	XX	28,248
Total	XX	[r]152,887	XX	180,433	XX	224,948

[r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fire clay; value included in "Combined value" figure.

[3] Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Washington, by county

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Adams	$63	W	Sand and gravel.
Asotin	517	$486	Stone, sand and gravel.
Benton	W	W	Sand and gravel, stone.
Chelan	1,421	790	Do.
Clallam	W	W	Clays, stone, sand and gravel.
Clark	W	2,046	Sand and gravel, stone, clays.
Columbia	102	124	Stone.
Cowlitz	916	1,032	Stone, sand and gravel.
Douglas	1,600	W	Do.
Ferry	4,296	6,014	Copper, gold, silver, stone, lead, zinc.
Franklin	W	937	Sand and gravel, stone.
Garfield	88	337	Stone.
Grant	W	W	Diatomite, lime, sand and gravel, stone.
Grays Harbor	1,214	1,181	Sand and gravel, stone.
Island	359	374	Do.
Jefferson	W	W	Stone, sand and gravel.
King	54,962	W	Cement, sand and gravel, stone, clays, peat.
Kitsap	W	4,423	Sand and gravel, stone, peat.
Kittitas	W	W	Stone, sand and gravel, clays.
Klickitat	W	340	Stone, sand and gravel.
Lewis	W	W	Sand and gravel, stone, pumice.
Lincoln	318	472	Sand and gravel, stone.
Mason	W	12	Stone.
Okanogan	679	W	Sand and gravel, stone, gypsum.
Pacific	613	786	Stone.
Pend Oreille	13,886	W	Cement, stone, sand and gravel.
Pierce	W	W	Sand and gravel, lime, stone, clays.
San Juan	W	W	Sand and gravel.

See footnotes at end of table.

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Table 2.—Value of nonfuel mineral production in Washington, by county —Continued

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Skagit	W	W	Olivine, sand and gravel, stone, talc.
Skamania	$390	$373	Stone, sand and gravel, pumice.
Snohomish	W	W	Sand and gravel, stone, clays.
Spokane	W	W	Sand and gravel, stone, clays, peat.
Stevens	[r]4,828	5,312	Stone, sand and gravel, tungsten, silver, clays, copper, lead.
Thurston	W	W	Sand and gravel, stone, peat.
Wahkiakum	10	7	Stone.
Walla Walla	950	728	Sand and gravel, stone.
Whatcom	W	W	Cement, stone, sand and gravel, gold, silver.
Whitman	248	--	
Yakima	W	W	Sand and gravel, stone, lime.
Undistributed[1]	65,427	154,659	
Total	[r]152,887	180,433	

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1]Includes sand and gravel, stone, and gem stones that cannot be assigned to specific counties, and values indicated by symbol W.

Table 3.—Indicators of Washington business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force thousands	1,651.0	1,767.0	1,892.0	+7.1
Unemployment do.	145.0	121.0	123.0	+1.7
Employment (nonagricultural):				
Mining[1] do.	2.3	2.8	NA	--
Manufacturing do.	260.0	285.4	NA	--
Contract construction do.	77.6	94.8	NA	--
Transportation and public utilities do.	78.9	85.0	NA	--
Wholesale and retail trade do.	329.0	364.7	NA	--
Finance, insurance, real estate do.	75.0	84.4	NA	--
Services do.	249.3	276.1	NA	--
Government do.	294.9	304.2	NA	--
Total nonagricultural employment[1] do.	1,367.0	1,497.3	NA	--
Personal income:				
Total millions	$27,871	$32,275	$37,041	+14.8
Per capita	$7,572	$8,553	$9,435	+10.3
Construction activity:				
Number of private and public residential units authorized	61,771	[2]61,557	51,449	-16.4
Value of nonresidential construction millions	$532.4	$807.2	$1,141.4	+41.4
Value of State road contract awards do.	$205.0	$155.0	$330.0	+112.9
Shipments of portland and masonry cement to and within the State thousand short tons	1,365	1,644	1,857	+13.0
Nonfuel mineral production value:				
Total crude mineral value millions	[r]$152.9	$180.4	$224.9	+24.7
Value per capita, resident population	[r]$42	$48	$57	+18.8
Value per square mile	[r]$2,242	$2,646	$3,299	+24.7

[p]Preliminary. [r]Revised. NA Not available.

[1]Includes bituminous coal extraction.

[2]Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

conducted hearings throughout the State to amend the State regulations by adopting requirements of the Federal Clean Air Act. State Implementation Plans (SIP) were submitted to the Federal Environmental Protection Agency. Although air quality in Washington is good, some problem areas remain, and the objective of the revised SIP is to achieve and maintain acceptable air quality standards in all areas.

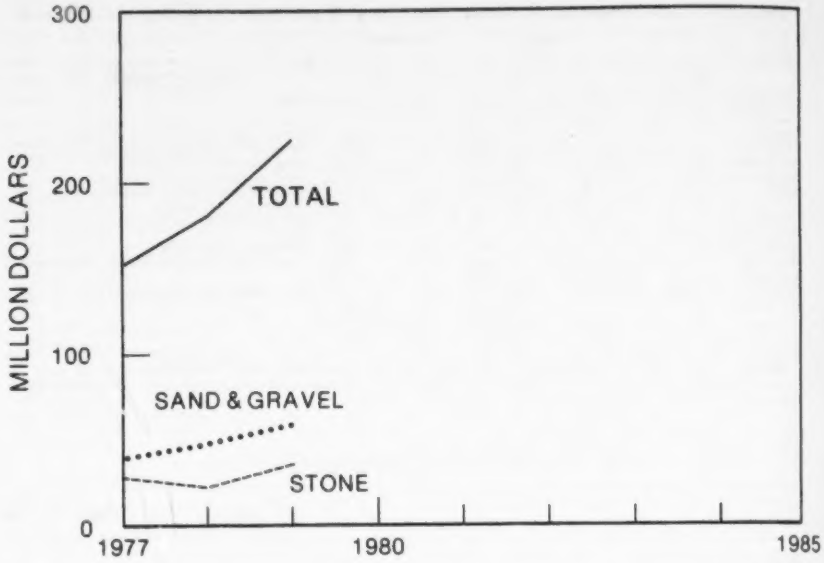

Figure 1.—Value of sand and gravel and stone, and total value of nonfuel mineral production in Washington.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Every county in the State has a history of nonmetallic mineral production. The most significant production for the reporting period was in King, Whatcom, Pend Oreille, Pierce, Snohomish, Spokane, and Grant Counties. Based on value of production, portland cement, sand and gravel, and stone were the leading commodities.

Calcium Chloride.—Two companies in Pierce County produced calcium chloride; Hooper Chemical Corp. and Reichold Chemicals, Inc. In addition, both companies produced numerous other organic and inorganic compounds.

Cement.—Portland cement was produced by four companies — Columbia Cement Corp., Bellingham; Ideal Cement Co., Seattle; Leigh Portland Cement Co., Metaline Falls; and, Lone Star Industries, Inc., Seattle. Cement was used for ready-mix concrete, concrete product manufacture, and other uses. Quantity and value increases were noted for this commodity.

Clays.—Clays were produced in eight counties — Clallam, Clark, King, Kittitas, Pierce, Snohomish, Spokane, and Stevens. Production from Clallam, King, and Spokane Counties was in excess of 90% of the State total. Clays were used for portland cement, common brick, face brick, highway surfacing, and flue lining.

Diatomite.—Witco Chemical Corp. produced diatomaceous raw material for its processing plant at Quincy from a surface mine near George, in Grant County. Production was 15% greater in 1978 than in 1977, and 38% greater in 1979 than in 1978.

Gypsum.—Argo Minerals, Inc., mined crude gypsum in Okanogan County. Kaiser Gypsum Co., Inc., calcined gypsum at its plant in King County.

Lime.—Utah-Idaho Sugar Co. produced lime in Grant and Yakima Counties; Domtar Industries, Inc., produced lime in Pierce County. Major production was used in sugar refinery pulp, paper processing, and sewage treatment.

Olivine.—Northwest International, the largest olivine producer in the State, has been in existence 20 years. In 1978, production increased 13% compared with that in 1977, with value also increasing 13%. In

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1979, production increased 67% compared with 1978 statistics, with value increasing 39%.

Olivine Corp. utilized olivine in refractory bricks to line wood waste burners at several large timber mills in the northwest and in Alaska.

Peat.—Production of peat in 1978 was 9,567 short tons. It was valued at $124 thousand, a decrease of 17% in quantity, and a value increase of 6% compared with that for 1977. In 1979, production increased 10% compared with that of 1978; value increased 19%.

Sand and Gravel.—Most counties produced sand and gravel; however, King, Pierce, San Juan, and Snohomish Counties accounted for more than 50% of total production. Major uses were for concrete aggregate, roadbase and coverings, asphaltic concrete aggregate, fill, and concrete products. Uses are shown in table 4.

Table 4.—Washington: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	5,555	$11,962	$2.15	6,632	$15,496	$2.34	8,505	$22,919	$2.69
Plaster and gunite sands	NA	NA	NA	W	W	2.11	199	515	2.59
Concrete products	1,170	3,148	2.69	1,413	3,832	2.71	1,233	3,195	2.59
Asphaltic concrete	3,424	7,876	2.30	4,118	10,600	2.57	3,649	9,919	2.72
Roadbase and coverings	4,397	8,916	2.03	5,624	12,202	2.17	6,596	15,603	2.37
Fill	3,433	4,970	1.45	3,798	6,031	1.59	3,623	6,264	1.73
Snow and ice control	--	--	--	W	W	2.44	42	82	1.92
Railroad ballast	37	67	1.55	115	306	2.67	129	323	2.51
Other uses	340	765	2.25	213	459	2.16	283	561	1.99
Total[1] or average	18,356	37,693	2.05	22,150	49,440	2.23	24,258	59,382	2.45

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."
[1] Data may not add to totals shown because of independent rounding.

Table 5.—Washington: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	4,567	$8,688	$1.90	7,488	$17,269	$2.31	8,061	$19,146	$2.38
Gravel	13,789	29,006	2.10	14,662	32,173	2.19	16,197	40,236	2.48
Total[1] or average	18,356	37,693	2.05	22,150	49,440	2.23	24,258	59,382	2.45
Industrial sand	149	1,431	9.61	W	W	9.07	W	W	10.82
Grand total or average	18,505	39,124	2.11	W	W	2.23	W	W	2.52

W Withheld to avoid disclosing company proprietary data.
[1] Data may not add to totals shown because of independent rounding.

Stone.—Dimension stone quarried in Ferry, Pierce, Skagit, Stevens, Whatcom, and Yakima Counties was used for rubble, flagging, cut stone, rough blocks, and house stone veneer. Crushed stone was obtained from quarries in which annual production ranged from less than 25,000 tons to more than 500,000 tons. Approximately 15% of the commodity was obtained from quarries that produced less than 50,000 tons per year. About 25% came from quarries that produced more than 50,000 tons per year, but less than 100,000. Quarries producing more than 100,000 tons per year, but less than 500,000, accounted for approximately 40%, and those that produced in excess of 500,000 tons per year accounted for 20% of total production.

Table 6.—Washington: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	15	170	W	W	8	107
Poultry grit and mineral food	8	91	W	W	W	W
Bituminous aggregate	[r]1,281	3,359	1,154	3,204	1,279	3,618
Macadam aggregate	300	522	44	115	181	384
Dense-graded roadbase stone	943	1,644	1,795	3,749	2,638	6,029
Surface treatment aggregate	1,936	4,525	830	1,758	3,938	7,394
Other construction aggregate and roadstone	3,939	8,210	1,845	3,525	3,420	8,454
Riprap and jetty stone	1,779	3,850	2,003	4,826	1,506	3,888
Railroad ballast	295	583	358	692	423	1,185
Manufactured fine aggregate (stone sand)	9	17	W	W	49	148
Terrazzo and exposed aggregate	33	846	W	W	32	134
Cement manufacture	800	1,336	W	W	W	W
Ferrosilicon	37	W	W	W	W	W
Flux stone	W	3	--	--	--	--
Whiting or whiting substitute	--	--	--	--	(2)	2
Other fillers or extenders	--	--	--	--	(2)	2
Roofing granules	W	17	--	--	--	--
Glass manufacture	W	1,037	--	--	--	--
Fill	[r]379	445	164	290	15	19
Drain fields	2	W	W	W	--	--
Other uses[3]	484	1,498	1,595	3,900	1,700	4,419
Total[4]	12,239	28,156	9,789	22,059	15,192	35,783

[r] Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone, granite, marble (1977), sandstone, traprock, and other stone.

[2] Less than 1/2 unit.

[3] Includes stone used in concrete aggregate, lime manufacture (1977-78), filter stone (1978-79), refractory stone (1977), abrasives, chemical stone (1979), magnesium metal, and uses indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

Sulfur.—Three companies produced sulfur, sulfur dioxide (SO_2), or hydrogen sulfide (H_2S). Atlantic Richfield Co. produced sulfur in Whatcom County; Shell Oil Co. produced hydrogen sulfide in Skagit County; and ASARCO Incorporated produced liquid SO_2 in Pierce County.

METALS

Washington ranked first in the Nation in quantity and value of primary aluminum production, with approximately 25% of the United States total. Northwest Alloys, Inc., a subsidiary of Alcoa, at Addy, Stevens County, produced magnesium metal. Inland Zinc, Inc., Spokane, produced zinc oxide from zinc smelter skimmings, fertilizer pellets from lead-zinc sludge, and animal food supplements from magnesite sand. The Knob Hill gold mine, operated by Day Mines, Inc., near Republic, was reactivated in 1978. A silver mine in northeastern Stevens County shipped ore to the Asarco smelter at Tacoma, and to the Cominco smelter at Trail, British Columbia. Industrial Minerals Products of Ravensdale recycles slag and magnesia waste from the Addy operation. Two tungsten properties were active during 1978; however, status of the properties in 1979 is not known. Copper smelting and refining at Tacoma, using out-of-State feed, accounted for 5% and 6%, respectively, of total United States output in 1978-79. AMAX Inc., entered an agreement with the Colville Confederated Indian Tribes for mineral exploration and development of a deposit containing copper and molybdenum.

Exploration activities for precious and base metals were undertaken by numerous companies. Those for precious metals were scattered throughout the Okanogan Highlands and Cascade physiographic provinces. Base metal activities were undertaken in

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the Cascade Mountains and the Western Okanogan Highlands.

Aluminum.—Washington ranked first in the Nation in quantity and value of primary aluminum production. The seven aluminum reduction plants in the State obtained raw material feed from foreign sources, primarily Australia. Major increases in aluminum fabricating capabilities were predicted for the State, with expansion projects currently underway at two locations.

Kaiser Aluminum and Chemical Corp. completed about half of a $45 million modernization and expansion project at its Trentwood sheet and fabricating complex; this should enable them to meet projected increases in demand for flat-rolled aluminum products. At its Longview cable plant, Reynolds Metals Co. undertook a multimillion-dollar expansion program to increase manufacturing capabilities and improve productivity.

Table 7.—Washington: Primary aluminum plant production data

Year	Quantity (thousand short tons)	Percent of national total	Value (thousands)
1975	1,075	28	$847,908
1976	1,150	27	1,021,662
1977	1,032	23	1,064,799
1978	1,203	25	1,301,367
1979	1,211	24	1,476,957

The aluminum industry is a major consumer of electricity in the northwest; availability of relatively cheap electricity is the backbone of the industry. It is anticipated, based on present trends, that the cost of electricity from Bonneville Power Administration (BPA) may rise from a rate of 2.2 - 3.2 mills to 5.5 - 6.0 mills per kilowatt-hour. Over the past 35 years, the aluminum industry has utilized about one-third of total BPA output. Under several proposed regional plans, the cost of electricity to the industry could rise to 8.7 mills per kilowatt-hour.

Copper.—Mine production of copper in 1978 came from three operations in Ferry and Stevens Counties. Production in 1979 decreased significantly as the Lone Star Mining Corp. mined-out known ore reserves.

In January 1979, Asarco suspended operation of its Tacoma copper refinery. The company continued operating its smelter and byproduct production facilities. The Tacoma smelter is the only domestic source of metallic arsenic and arsenic trioxide. It has been a major exporter of refined copper, but during weak copper markets, export demand was soft. During the same period, increases in imports of low-cost world copper made it difficult for Asarco to redirect its product to domestic markets. In addition, the company has been confronted with pollution regulations. Copper anodes produced in Tacoma are scheduled for shipment to the firm's new plant in Amarillo, Tex., for refining.

Leaders of the Colville Confederated Tribes signed a multimillion-dollar agreement with AMAX for mineral exploration and development on Mount Tolman, Ferry County. The deposit being investigated was reported to contain more than 300 million tons of copper-molybdenum ore. The company is committed to spend in excess of $15 million in exploration costs. In addition, the agreement requires AMAX to train and employ tribal personnel.

Gold.—Gold was recovered from the ores of four mines in Ferry, Stevens, and Whatcom Counties in 1978, and from one mine in Ferry County in 1979. Gold mining resumed at the Knob Hill Mine, operated by Day Mines, Inc. State gold production, for a 3-year period (1977-79), averaged 17,992 troy ounces annually, with an average production value approaching $4 million. In 1977, production was 133% of the average, with the value of production 95%. In 1978, it was 81% and 75%, respectively, and in 1979, 89% and 130%. Exploration activities for gold were on the upswing, mainly throughout the Okanogan Highlands and Cascade physiographic provinces.

Magnesium.—The first full year of converting dolomite to magnesium, by Alcoa's Northwest Alloys plant in Stevens County, was 1978. The mine-plant complex has a labor force of about 400 employees; operations contribute about $500,000 annually to the county tax base. If the operational life meets expectations, Alcoa should continue its tax payments well into the next century.

Silver.—Silver was recovered in 1978 from the ores of four mines in Ferry, Stevens, and Whatcom Counties, and in 1979 from two mines in Ferry County. In 1978, silver ore was shipped from the Melrose Mine in northeastern Stevens County to Asarco's smelter at Tacoma, and to the Cominco smelter at Trail, British Columbia.

State silver production for 1978 and 1979 averaged about 56,000 ounces, a 54% decrease from production reported for 1977. Value of production received for the commodity in 1978 was 46% less than that of 1977; however, the value received for 1979 was 11% greater. Silver exploration activities followed the same trend as for gold, with 12 major companies conducting programs in similar geological environments.

Tungsten.—Tungsten, in the form of scheelite and wolframite, was produced from the Blue Grouse Mine, Stevens County.

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[1] State mineral specialist, Bureau of Mines, Spokane, Wash.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum:			
Aluminum Company of America	Box 120 Vancouver, WA 98660	Plant	Clark.
	Box 221 Wenatchee, WA 98801	do	Chelan.
Intalco Aluminum Corp	Box 937 Ferndale, WA 98248	do	Whatcom.
Kaiser Aluminum & Chemical Corp.	Box 6217 Spokane, WA 99207	do	Spokane.
	3400 Taylor Way Tacoma, WA 98400	do	Pierce.
Cement:			
Filtrol Corp.[1]	Marietta Rd. Box 37 Bellingham, WA 98225	do	Whatcom.
Lehigh Portland Cement Co.[1]	718 Hamilton St. Allentown, PA 18105	do	Pend Oreille.
Ideal Basic Industries Inc.[1] [2]	420 Ideal Cement Bldg. Denver, CO 80202	do	King.
Lone Star Industries, Inc.[3]	One Greenwich Plaza Greenwich, CT 06830	do	Do.
Clays:			
Interpace Corp	2901 Los Feliz Blvd. Los Angeles, CA 90039	Pits and plants	King, Spokane, Stevens.
Mutual Materials Co	Box 2009 Bellevue, WA 98009	do	King and Pierce.
Copper: ASARCO, Inc.[4]	Box 1605 Tacoma, WA 98401	Plant	Pierce.
Dolomite: Witco Chemical Corp	277 Park Ave. New York, NY 10017	Mine and plant	Grant.
Gold: Day Mines, Inc.[5]	Box 1010 Wallace, ID 83873	Mine and mill	Ferry.
Lime:			
Domtar Industries, Inc	1220 Alexander Ave. Tacoma, WA 98421	Plant	Pierce.
Utah-Idaho Sugar Co	Drawer 970 Moses Lake, WA 98837	do	Grant.
	Box 752 Toppenish, WA 98948	do	Yakima.
Magnesium: Northwest Alloys, Inc	Box 115 Addy, WA 99101	Plant and mine	Stevens.
Olivine: Northwest International	329 Kincaid St. Mount Vernon, WA 98273	do	Skagit.
Peat:			
Cunningham Sand and Gravel Co., Inc.	North 8510 Crestline Spokane, WA 99208	Bog	Spokane.
Maple Valley Humus	18805 SE. 170th St. Renton, WA 98055	Bog	Snohomish.
Sand and gravel:			
Associated Sand & Gravel Co., Inc	Box 2037 Everett, WA 98203	Pit and plant	Benton and Spokane.
Cadman Gravel Co	18816 NE. 80th Redmond, WA 98052	do	King.
Central Premix Concrete Co	805 North Division Spokane, WA 99220	do	Various.
Friday Harbor S & G Co	Box 8 Bellingham, WA 98225	do	San Juan.
Lakeside Sand & Gravel Co., Inc	Box 46 Issaquah, WA 98027	do	King.
Lone Star Industries, Inc	Box 1020 Seattle, WA 98111	do	Pierce.
Miles Sand & Gravel Co	Box 130 Auburn, WA 98002	do	King and Kitsap.
Woodworth & Co., Inc	1200 East D St. Tacoma, WA 98421	do	Pierce.

See footnotes at end of table.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Stone:			
B & K Paving	Box 1379 Bellevue, WA 98009	Quarry	Clark.
Black River Quarry, Inc	6808 South 140th St. Seattle, WA 98178	do	King.
DeAtley Corp	Box 648 Lewiston, ID 83501	Quarries	Asotin.
General Construction Co	Box 3845 Seattle, WA 98124	Quarries and plant	Jefferson.
Harbor Rock, Inc	Box 246 South Bend, WA 98586	Quarries	Pacific.
Lane Mountain Silica Co	Box 236 Valley, WA 99181	Quarry	Stevens.
Pacific Quarries, Inc	1860 Hickory Rd. Mount Vernon, WA 98273	do	Skagit.
Stoen Construction Co	Box 488 Kenmore, WA 98028	Quarries	King and Snohomish.
U.S. Forest Service, Region I	Box 3623 Portland, OR 97208	do	Various.
Washington Highway Department.	Box 327 Olympia, WA 98504	do	Do.
Woodworth and Co., Inc	1200 E St. Tacoma, WA 98421	do	Pierce.

[1] Also stone.
[2] Also clays.
[3] Also sand and gravel.
[4] Also arsenic, gold, and silver.
[5] Also silver, copper, and lead.

The Public Library, Newark, N.J.

The Mineral Industry of West Virginia

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the West Virginia Geological and Economic Survey, for collecting information on all nonfuel minerals.

By Donald K. Harrison[1]

The value of West Virginia's nonfuel mineral production in 1978 and 1979 was $103.5 million and $118.6 million, respectively. Both quantity and value of mineral output increased in each consecutive year since 1977. In 1979, crushed stone accounted for 32% of the total nonfuel mineral value in the State. The combined value of cement, fire clay, lime, and salt production in 1979 added another 36% to the total.

Salt production continued to be utilized primarily by chemical companies for the manufacture of chlorine and caustic soda. The chemical industry in West Virginia contributes the largest share of value added to the State's gross manufacturing product.

West Virginia is one of the leading manufacturers of glassware because of the abundance and quality of industrial sand in the State. In 1979, there were 29 companies involved in glassmaking employing 64,000 workers earning $70 million.

Trends and Developments.—In 1979 West Virginia reached an agreement with the Environmental Protection Agency to coordinate environmental activities. The agreement is a new approach designed to address, coordinate, and resolve environmental problems in the State. Major areas of focus include acid mine drainage, hazardous waste handling and disposal, and solid waste management.

Despite an increase in the production of crushed stone in the State, local shortages occurred. The State Department of Highways' road stabilization program, aimed at improving the State's road system, raised the demand for aggregate above normal levels. The shortage forced many road contractors to obtain stone from as far away as Indiana and Kentucky. In 1977, the highway agency earmarked $2 million for the program but expanded the figure in 1978 to nearly $15 million.

Investments in new and expanded processing and manufacturing plants directly dependent on mineral raw materials fell to $30 million in 1978 from $40.5 million in 1977. Investments in 1979 made a marked recovery, amounting to $42 million. As a result, more than 1,300 jobs were created by the new and additional processing facilities.

Legislation and Government Programs.—In late 1978, the Secretary of the Interior designated West Virginia University at Morgantown as a State Mining and Mineral Resources and Research Institute. West Virginia University is one of 31 schools and universities in the United States chosen to establish training programs in mining and minerals extraction pursuant to Title III of Public Law 95-87. Annual allotments were provided to the university through fiscal 1984. The institute initially received a basic grant of $110,000

Table 1.—Nonfuel mineral production in West Virginia[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays[2] ---------- thousand short tons--	389	$599	343	$575	330	$502
Gem stones ----------------------	NA	2	--	--	--	--
Salt ---------- thousand short tons--	1,048	W	1,030	W	1,078	W
Sand and gravel[3] -------------- do----	3,891	10,402	3,264	13,050	4,133	18,501
Stone (crushed) --------------- do----	10,495	28,022	11,582	32,897	11,713	37,624
Combined value of cement, clays (fire), lime, sand and gravel (industrial), stone (dimension), and values indicated by symbol W --	XX	47,569	XX	56,996	XX	61,878
Total ----------------------	XX	86,594	XX	103,518	XX	118,505

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fire clay; value included in "Combined value" figure.

[3] Excludes industrial sand; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in West Virginia, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Berkeley ----------------	$26,188	$29,841	Cement, stone, lime, clays.
Boone ----------------	210	210	Stone.
Braxton ----------------	2	([2])	Do.
Brooke ----------------	--	W	Sand and gravel.
Cabell ----------------	16	18	Clays.
Fayette ----------------	W	W	Stone.
Gilmer ----------------	W	W	Do.
Grant ----------------	258	266	Do.
Greenbrier ----------------	W	W	Do.
Hampshire ----------------	W	W	Do.
Hancock ----------------	W	W	Sand and gravel, clays.
Harrison ----------------	603	W	Stone.
Jackson ----------------	W	--	
Jefferson ----------------	W	W	Stone.
Kanawha ----------------	W	W	Do.
Lincoln ----------------	8	W	Clays.
Marion ----------------	190	21	Stone.
Marshall ----------------	W	W	Salt.
Mason ----------------	44	77	Sand and gravel.
Mercer ----------------	W	1,372	Stone.
Mineral ----------------	W	W	Do.
Monongalia ----------------	W	W	Do.
Monroe ----------------	1	--	
Morgan ----------------	W	W	Sand and gravel.
Pendleton ----------------	W	W	Lime, stone.
Pocahontas ----------------	W	663	Stone.
Preston ----------------	W	989	Do.
Raleigh ----------------	1,271	1,358	Do.
Randolph ----------------	3,567	3,897	Do.
Roane ----------------	64	--	
Tucker ----------------	W	W	Stone.
Tyler ----------------	W	W	Salt.
Wetzel ----------------	W	W	Sand and gravel.
Wirt ----------------	20	--	
Wood ----------------	--	W	Sand and gravel.
Wyoming ----------------	--	W	Do.
Undistributed[3] ----------------	54,151	64,810	
Total[4] ----------------	86,594	103,518	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Barbour, Brooke, Calhoun, Clay, Doddridge, Hardy, Lewis, Logan, McDowell, Mingo, Nicholas, Ohio, Pleasants, Putnam, Ritchie, Summers, Taylor, Upshur, Wayne, and Webster Counties are not listed because no nonfuel mineral production was reported.

[2] Less than 1/2 unit.

[3] Includes gem stones (1977) that cannot be assigned to specific counties and values indicated by symbol W.

[4] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of West Virginia business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	691.0	720.0	751.0	+4.3
Unemployment	do	49.0	46.0	51.0	+10.9
Employment (nonagricultural):					
Mining[1]	do	66.7	56.7	66.0	+16.4
Manufacturing	do	123.8	126.6	126.0	+.5
Contract construction	do	39.0	43.7	40.5	-7.3
Transportation and public utilities	do	40.7	40.2	43.7	+8.7
Wholesale and retail trade	do	123.4	131.8	132.7	+.7
Finance, insurance, real estate	do	20.0	21.2	21.5	+1.4
Services	do	86.9	92.7	95.1	+2.6
Government	do	111.0	116.6	120.2	+3.1
Total nonagricultural employment[1]	do	611.6	629.5	[2]645.6	+2.6
Personal income:					
Total	millions	$11,118	$12,327	$14,029	+13.8
Per capita		$5,999	$6,629	$7,470	+12.7
Construction activity:					
Number of private and public residential units authorized		3,519	[3]4,352	4,317	-.8
Value of nonresidential construction	millions	$72.0	$89.2	$469.6	-22.0
Value of State road contract awards	do	$250.0	NA	$390.0	--
Shipments of portland and masonry cement to and within the State	thousand short tons	632	673	631	-6.2
Nonfuel mineral production value:					
Total crude mineral value	millions	$86.6	$103.5	$118.6	+14.6
Value per capita, resident population		$47	$56	$63	+12.5
Value per square mile		$3,581	$4,281	$4,904	+14.6

[p] Preliminary. NA Not available.

[1] Includes bituminous coal and oil and gas extraction.

[2] Data do not add to totals shown because of independent rounding.

[3] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

plus $160,000 for scholarships and fellowships.

In accordance with the provisions of the Wilderness Act (PL 88-577) and the Eastern Wilderness Act (PL 93-622), the mineral resource potential of two wilderness areas in West Virginia were jointly investigated by the Federal Bureau of Mines and the U.S. Geological Survey (USGS). A USGS Open-File Report (OFR 78-142), entitled "Mineral Resources of the Cranberry Wilderness Study Area, Pocahontas and Wyoming Counties, W. Va.," was published in 1978. Bureau of Mines and USGS personnel conducted a field investigation in 1978 in the Otter Creek Wilderness Area, Tucker and Randolph Counties. Results of the investigation are scheduled to be published in 1980.

State legislation was enacted that limits mining in the Cranberry Wilderness Study Area. No new prospecting or surface mining permits are to be issued, and any existing permits for surface or underground mining within or underneath the area will be terminated. All land restoration and reclamation required by this legislation was to be completed before January 1, 1979. Since no recent mining has occurred in the Wilderness Study Area, no land restoration or reclamation was necessary.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—Martin Marietta Corp., the only producer of both portland and masonry cement in the State, operated three coal-fired kilns at its plant at Martinsburg in Berkeley County. Most of the cement was used in ready-mixed concrete and concrete products. In addition to in-State consumption, shipments were made to the District of Columbia, Maryland, North Carolina, Pennsylvania, and Virginia.

Clays.—Common clay and fire clay were produced by six companies in Berkeley, Cabell, Hancock, and Lincoln Counties. Fire clay production remained essentially con-

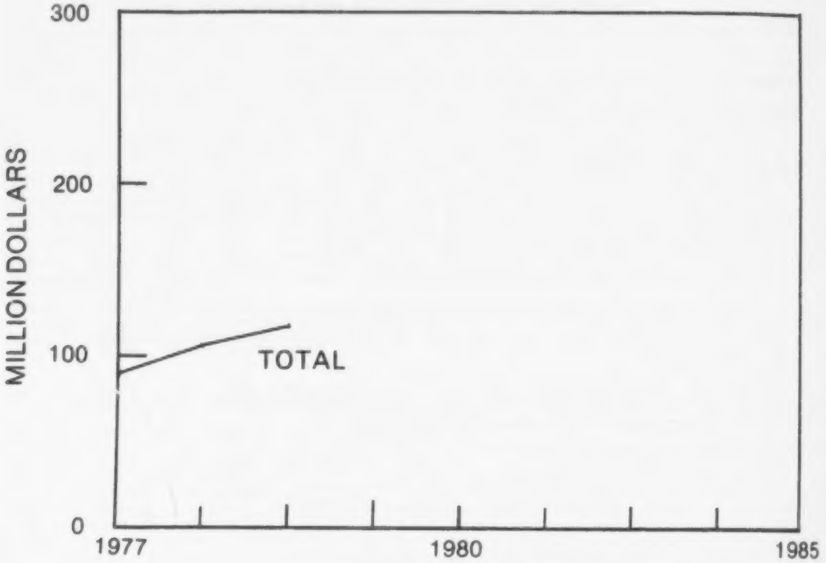

Figure 1.—Total value of nonfuel mineral production in West Virginia.

stant in 1978, but increased nearly 6% in 1979. Production of common clay decreased in 1978 and again in 1979. Berkeley County continued to be the leading producer of common clay; Hancock County was the only producer of fire clay. Principal uses were in the manufacture of face brick, fire brick, and cement.

Iron Oxide Pigments.—Production of synthetic iron oxide increased substantially in 1979 as the result of a new plant coming online at New Martinsville. The plant, owned by Mobay Chemical Corp., will be the largest facility of its kind in the United States when fully operational. Production of synthetic iron oxide pigments began in the last quarter of 1978; first shipments began early in 1979. Construction continued on the second stage of the plant, which will have an annual production capacity of 45,000 tons per year.

Lime.—Production of lime was reported by two companies during 1978 and 1979. Both quicklime and hydrated lime were produced in Pendleton County; quicklime was also produced in Berkeley County. Output and value remained essentially the same in 1977 and 1978, but increased 19% in tonnage and 17% in value in 1979.

Salt.—Three companies recovered salt at deepwell solution mining operations in Marshall and Tyler Counties. Production essentially remained constant during the biennium. The salt was used by the producers for manufacturing chlorine, caustic soda, and other chemicals.

Sand and Gravel.—Output of construction sand and gravel in 1978 decreased 16% compared with that of 1977. The major cause of the decrease was the lowered demand for ready-mixed concrete used in the construction of houses and heavy industrial projects. The number of houses built in 1978 was down, and other types of commercial construction, as well as highway construction, also declined. Production in 1979 rose above the 1977 output primarily due to increased demand for the State's road stabilization program. Sand and gravel constituted 13% and 16% of the State's total nonfuel mineral value in 1978 and 1979, respectively.

Seven companies produced sand and gravel at eight operations in seven counties in 1979. Leading counties, in order of output, were Wetzel, Brooke, and Morgan. Trucks transported approximately 75% of the material; the remainder was shipped by rail and barge.

Construction sand and gravel comprised the bulk of the aggregate produced. It was used primarily in concrete aggregate and asphalt.

Industrial sand was produced at two operations in Morgan and Wyoming Counties. Output increased in 1978, compared with that in 1977, and remained essentially the same in 1979. It was primarily used by the State's glass manufacturing industry.

In early 1979, Brockway Glass Co. sold its Clarksburg plant to Anchor Hocking Corp., a Lancaster, Ohio, tableware manufacturer. Anchor Hocking reopened the plant and announced plans to modernize and upgrade the facility. Most of the work force was expected to be recalled within a year of the reopening. In the same year, Ashahi Glass Co. of Japan made a $12 million investment in the Hordis Glass Co. in Clarksburg. The plant will reopen in June 1980, under the name of West Virginia Flat Glass, Inc.

Stone.—Crushed stone was produced by 41 companies at 47 mines and quarries in 22 counties in 1978. The industry was similarly structured in 1979. It was used principally for roadstone and concrete aggregate. In 1979 the leading producers of crushed stone in terms of tonnage were Greer Limestone Co., Martin Marietta Corp., and Shenandoah Quarry, Inc. Howard W. Fields Co. quarried dimension sandstone in Greenbrier County for rough flagging.

Crushed limestone was produced in 13 counties at 31 mines and quarries. Leading counties in production were Monongalia, Greenbrier, Berkeley, and Jefferson. Major uses were for construction aggregate, roadbase, concrete, riprap, agriculture, railroad ballast, abrasives, and mine dusting.

Crushed sandstone was produced in 10 counties at 14 quarries. Counties that led in output were Raleigh, Logan, Wyoming, and

Table 4.—West Virginia: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,587	$4,996	$3.15	2,138	$8,829	$4.13	2,638	$11,822	$4.48
Plaster and gunite sands	NA	NA	NA	W	W	4.25	W	W	4.85
Concrete products	1,462	3,760	2.57	W	W	4.08	W	W	4.84
Asphaltic concrete	89	342	3.86	W	W	3.60	W	W	4.27
Roadbase and coverings	169	253	1.50	W	W	4.01	W	W	4.48
Fill	367	537	1.47	W	W	3.88	W	W	4.59
Snow and ice control	--	--	--	W	W	3.25	--	--	--
Other uses	217	514	2.37	60	117	1.94	7	30	4.53
Total[1] or average	3,891	10,402	2.67	3,264	13,050	4.00	4,138	18,501	4.47

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Total."
[1] Data may not add to totals shown because of independent rounding.

Table 5.—West Virginia: Construction sand and gravel sold or used by producers

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	2,017	$5,401	$2.68	1,800	$7,026	$3.90	2,405	$10,624	$4.42
Gravel	1,874	5,001	2.67	1,464	6,028	4.12	1,733	7,876	4.55
Total[1] or average	3,891	10,402	2.67	3,264	13,050	4.00	4,138	18,501	4.47

[1] Data may not add to totals shown because of independent rounding.

Table 6.—West Virginia: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	126	487	106	401	83	348
Concrete aggregate	r1,090	r2,734	2,000	5,019	2,233	6,149
Bituminous aggregate	304	901	380	1,264	360	1,238
Macadam aggregate	9	27	W	W	W	W
Dense-graded roadbase stone	2,207	6,598	2,045	6,686	2,445	8,999
Surface treatment aggregate	554	1,416	545	1,493	526	1,728
Other construction aggregate and roadstone	2,311	6,552	2,593	7,897	2,728	9,342
Riprap and jetty stone	39	130	58	203	84	325
Railroad ballast	592	1,137	649	1,299	650	1,289
Manufactured fine aggregate (stone sand)	435	1,411	569	2,050	513	2,012
Abrasives	W	W	106	353	62	209
Mine dusting	173	1,415	121	496	139	1,216
Other uses[2]	2,656	5,214	2,410	5,736	1,89[illegible]	4,770
Total[3]	10,495	28,022	11,582	32,897	11,713	37,624

r Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."

[1] Includes limestone and sandstone.

[2] Includes stone used in agricultural marl and other soil conditioners, poultry grit and mineral food (1979), filter stone, cement manufacture, lime manufacture, flux stone, refractory stone, asphalt filler (1979), fill, disinfectant (1977), sulfur dioxide, unspecified uses, and uses indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Kanawha. Major uses were in construction and glassmaking.

METALS

Although West Virginia has no metal mines, the metal-processing industry plays a significant role in the State's economy. Located largely near navigable waterways, producers of steel, ferroalloys, nickel, and aluminum processed imported ores. Locally produced raw materials and electrical power were used in their operations.

Aluminum.—Kaiser Aluminum & Chemical Corp. produced aluminum at its 163,000 tpy primary aluminum smelter at Ravenswood, Jackson County. Imported bauxite is refined to alumina in Louisiana, then shipped by rail or barge to Ravenswood where it is converted to molten aluminum by a reduction process in the plant's four potlines.

Since 1957, Kaiser has continually upgraded and modernized its Ravenswood plant. The company spent approximately $18 million during 1979. In addition to improvements in the casting department and in handling equipment, Kaiser built a new barge and unloading facility at Ravenswood. The facility, on the Ohio River, was completed in early 1979, and can now receive boat shipments of alumina from Louisiana. Prior to completion of the barge facilities, all shipments were supplied by rail.

Alcan Aluminum Corp. began a $5 million modernization program of its facilities at Fairmont in Marion County. The first phase included installation of new electrical and hydraulic systems on a cold rolling mill. A second phase includes the rebuilding of floors in the plant to withstand heavier loads. The plant, which employs 300 workers, serves the specialty aluminum sheet markets, fabricating aluminum fin stock for heat exchangers, blanks for cookware, lamp base stock, and transformer strip.

Ferroalloys.—Three companies produced 150,126 short tons and 172,481 short tons of ferroalloys during 1978 and 1979, respectively. Ferroalloys were produced by Union Carbide Corp. at its alloy plant in Fayette County, the Foote Mineral Co. at its Graham plant in Mason County, and Chemetal Corp.'s plant at Kingwood in Preston County. The Chemetal Corp., previously owned by the Diamond Shamrock Chemical Co., was purchased by Sedema S.A. of Belgium in 1978.

Iron and Steel.—Production of pig iron increased 16% in 1978 and remained essentially the same in 1979.

Weirton Steel Co. Division of National Steel Corp. was granted permission by the State Air Pollution Control Commission to delay shutdown of one of the firm's coke batteries because of the lack of air pollution controls. In 1978, the company had agreed to shut down the battery citing that it would not be economically feasible to retrofit the unit to meet air quality standards set by State and Federal agencies. This action, however, would have necessitated the import of foreign coke, ultimately affecting approximately 230 steel and coal mining jobs in the State.

Nickel.—Huntington Alloys, Inc., Division of The International Nickel Co., Inc., produced wrought- and high-nickel alloys at its Huntingtion plant in Cabell County. These alloys are used by the chemical, aerospace, welding, and heating industries.

Zinc.—The Meadowbrook Corp., a wholly owned subsidiary of T. L. Diamont and Co., Inc., operated a zinc plant at Spelter, Harrison County. Zinc drosses, ashes, and other residues were used to produce zinc dust, oxides, and other zinc products.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement: Martin Marietta Corp.[1]	6801 Rockledge Dr. Bethesda, MD 20034	Plant	Berkeley.
Clays:			
Barboursville Clay Manufacturing Co.	Box 258 Barboursville, WV 25504	Pit	Cabell.
Continental Clay Products Co	Box 1111 Martinsburg, WV 25401	Pit	Berkeley.
Crescent Brick Co., Inc	Box 368 New Cumberland, WV 26047	Underground mine	Hancock.
Globe Refractories, Inc	Box D Newell, WV 24050	do	Do.
Iron oxide pigments, finished:			
Chemetron Corp	491 Columbia Ave. Holland, MI 49423	Plant	Cabell.
National Steel Corp., Weirton Steel Div.	Weirton, WV 26062	do	Hancock.
Mobay Chemical Corp	Penn Lincoln Parkway West Pittsburgh, PA 15205	do	Wetzel.
Lime:			
Greer Limestone Co	Greer Bldg. Morgantown, WV 26505	do	Pendleton.
Riverton Corp	Riverton, VA 22651	do	Berkeley.
Salt:			
Allied Chemical Corp	Box 1219R Morristown, NJ 07960	Brine wells and plant	Marshall.
FMC Corp	Box 8127 South Charleston, WV 25303	Brine wells	Tyler
PPG Industries, Inc	1 Gateway Center Pittsburgh, PA 15222	Brine wells and plant	Marshall.
Sand and gravel:			
Dravo Corp	1 Oliver Plaza Pittsburgh, PA 15222	Dredge	Hancock.
McDonough Co	Box 538 Parkersburg, WV 26100	do	Tyler and Wetzel.
Pennsylvania Glass Sand Corp	Berkeley Springs, WV 25411	Plant	Morgan.
Shippingport Sand and Gravel Co.	1200 Stambaugh Bldg. Youngstown, OH 44501	do	Hancock.
Smelters: Kaiser Aluminum & Chemical Corp.	300 Lakeside Dr. Oakland, CA 94626	do	Jackson.
Stone:			
Acme Limestone Co	Box 27 Fort Spring, WV 24936	Mine and quarry	Greenbrier.
Elkins Limestone Co	Box 1228 Elkins, WV 26241	do	Randolph.
The H. Frazier Co., Inc	Box 1877 Richmond, VA 23211	Quarry	Greenbrier.
Greer Limestone Co., a division of Greer Steel Co.	Greer Bldg. Morgantown, WV 26505	Mine and quarries	Monongalia and Pendleton.
Martin Marietta Corp	6801 Rockledge Dr. Bethesda, MD 20034	Quarry	Berkeley.
Pennsylvania Glass Sand Corp	Box 187 Berkeley Springs, WV 25411	do	Morgan.
Shenandoah Quarry, Inc	Box C Millville, WV 25432	do	Jefferson.
United States Steel Corp	600 Grant St. Pittsburgh, PA 15230	do	Do.

[1] Also clays.

The Mineral Industry of Wisconsin

This chapter has been prepared by the Bureau of Mines, U.S. Department of the Interior, and the Geological and Natural History Survey of Wisconsin, under a Memorandum of Understanding for collecting information on all nonfuel minerals in the State.

By James J. Hill[1] and Thomas J. Evans[2]

The value of nonfuel mineral production in Wisconsin was $159.2 million in 1978 and $179.7 million in 1979. The increase in value primarily reflects inflationary pressures that have caused the unit values of most mineral commodities to escalate along with other products in the State's economy.

Nonmetallic minerals, especially sand and gravel and crushed stone used for construction, continued to dominate the mineral scene in quantity and value.

In the 1978-79 biennium, iron ore was the leading metallic mineral commodity produced in Wisconsin. With the closing of Eagle-Picher Industries' zinc mine in October 1979, iron ore became the sole metallic mineral produced in the State.

Although three massive sulfide deposits have been discovered in the State since 1968, only one is currently being evaluated for production purposes.

Table 1.—Nonfuel mineral production in Wisconsin[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Gem stones	NA	$1	--	--	--	--
Iron ore (usable) thousand long tons, gross weight	668	W	650	W	736	W
Lime thousand short tons	378	13,521	430	$17,301	429	$19,060
Peat do	14	196	12	201	11	720
Sand and gravel do	29,025	50,210	30,474	53,012	32,046	58,576
Stone:						
Crushed do	22,241	42,097	24,385	46,990	23,924	52,804
Dimension do	73	4,821	64	4,562	54	4,204
Combined value of abrasive stone, cement, clays, lead, zinc, and values indicated by symbol W	XX	39,282	XX	37,162	XX	44,318
Total	XX	150,128	XX	159,228	XX	179,682

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Wisconsin, by county

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Adams	$74	W	Sand and gravel.
Ashland	78	$65	Do.
Barron	1,334	1,217	Do.
Bayfield	W	W	Do.
Brown	W	W	Lime, stone, sand and gravel.
Buffalo	782	280	Stone, sand and gravel.
Burnett	745	851	Sand and gravel.
Calumet	W	W	Stone, sand and gravel.
Chippewa	1,042	843	Sand and gravel.
Clark	656	374	Sand and gravel, stone.
Columbia	W	W	Do.
Crawford	W	W	Do.
Dane	4,376	W	Stone, sand and gravel.
Dodge	W	W	Lime, stone, sand and gravel.
Door	1,036	706	Sand and gravel, stone.
Douglas	W	W	Lime, cement, sand and gravel, stone.
Dunn	W	W	Stone, sand and gravel.
Eau Claire	1,271	495	Sand and gravel.
Florence	29	19	Do.
Fond du Lac	W	W	Stone, sand and gravel, lime, clays.
Forest	79	84	Sand and gravel.
Grant	W	W	Stone, sand and gravel.
Green	W	W	Do.
Green Lake	1,530	3,949	Sand and gravel.
Iowa	645	338	Stone.
Iron	W	W	Sand and gravel.
Jackson	W	W	Iron ore, sand and gravel.
Jefferson	358	515	Stone, sand and gravel.
Juneau	W	W	Do.
Kenosha	1,280	3,875	Sand and gravel.
Kewaunee	538	1,044	Do.
La Crosse	W	W	Stone, sand and gravel.
Lafayette	W	W	Zinc, stone, lead.
Langlade	W	W	Sand and gravel.
Lincoln	317	339	Do.
Manitowoc	7,212	8,423	Cement, lime, stone, sand and gravel.
Marathon	6,755	8,341	Stone, sand and gravel.
Marinette	2,353	2,718	Do.
Marquette	W	W	Sand and gravel, stone.
Menominee	--	--	
Milwaukee	W	W	Cement, stone.
Monroe	935	916	Stone.
Oconto	1,010	822	Sand and gravel, stone.
Oneida	728	789	Sand and gravel.
Outagamie	W	W	Stone, sand and gravel.
Ozaukee	W	W	Sand and gravel, stone.
Pepin	W	W	Stone, sand and gravel.
Pierce	W	W	Do.
Polk	3,394	W	Do.
Portage	1,408	1,051	Sand and gravel.
Price	102	66	Do.
Racine	2,659	3,217	Stone, sand and gravel.
Richland	W	W	Do.
Rock	2,222	2,742	Sand and gravel, stone.
Rusk	3,254	773	Sand and gravel.
St. Croix	731	708	Stone, sand and gravel.
Sauk	W	W	Stone, sand and gravel, abrasive stone.
Sawyer	314	W	Sand and gravel.
Shawano	W	840	Sand and gravel, stone.
Sheboygan	1,174	1,283	Do.
Taylor	1,230	1,541	Sand and gravel.
Trempealeau	W	W	Stone.
Vernon	W	W	Stone, sand and gravel.
Vilas	515	728	Sand and gravel.
Walworth	778	891	Sand and gravel, stone.
Washburn	W	W	Sand and gravel.
Washington	W	W	Sand and gravel, stone.
Waukesha	12,733	13,943	Sand and gravel, stone, peat.
Waupaca	1,050	746	Sand and gravel, stone.
Waushara	W	W	Do.
Winnebago	3,943	4,409	Stone, sand and gravel.
Wood	W	155	Stone.
Undistributed[1]	79,453	89,107	
Total[2]	150,128	159,228	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Includes gem stones (1977), sand and gravel that cannot be assigned to specific counties, and values indicated by symbol W.

[2] Data may not add to totals shown because of independent rounding.

Employment.—During 1978 and 1979, employment in the mining and mineral-user-related industries accounted for more than 9% of the State's employed labor force. These industries included contract construction (residential, commercial, industrial, roads and highways); stone, clay, and glass products manufacture; concrete, gypsum, and plaster-produced goods; the primary metals; iron and steel foundry heavy metal output; and the fabrication of metal products. In the above group, the fabricated metals industry ranks third in employed workers and also third in value added to the State's gross income. Per capita pay scale for these industrial manufacturing categories was the highest paid to all wage earners contributing to the State's gross product.

Wisconsin led the Nation in producing many major types of mining and construction equipment. Milwaukee is one of the leading mine machinery centers of the world.

Trends and Developments.—Since the discovery of three massive sulfide deposits in north-central Wisconsin in the 1968-76 period by Kennecott Copper Corp., Noranda Exploration Co., and Exxon Minerals Co. U.S.A., many companies have focused their exploration efforts on Wisconsin. Base metal exploration continued at a high pace in 1978 and 1979.

Exploration for base metals in the north-central part of the State has been concentrated on a 70-mile-wide band from Ladysmith (Rusk County) in the west through the Rhinelander-Crandon area (Oneida and Forest Counties) and to the Pembine area in the east (Marinette County), a distance of about 250 miles.

In 1978, 14 companies were licensed by the State to explore for mineral commodities. By the end of the year, 228 holes had been drilled with the footage approximating 365,900 feet. About 350,000 feet of this drilling was attributed to Exxon's development drilling at the Crandon zinc-copper deposit in Forest County.

Fifteen companies were licensed to explore in 1979. By the end of the year, 28 holes were drilled and footage approximated 29,500 feet. No new discoveries of mineral deposits were announced as a result of this activity.

Table 3.—Indicators of Wisconsin business activity

		1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:					
Total civilian labor force	thousands	2,214.0	2,310.0	2,381.0	+3.1
Unemployment	do.	109.0	118.0	108.0	-8.5
Employment (nonagricultural):					
Mining	do.	2.6	2.6	2.7	+3.8
Manufacturing	do.	540.4	569.7	592.5	+4.0
Contract construction	do.	73.7	78.5	81.4	+3.7
Transportation and public utilities	do.	85.4	88.4	92.3	+4.4
Wholesale and retail trade	do.	409.8	426.6	446.2	+4.6
Finance, insurance, real estate	do.	81.0	85.7	90.7	+5.8
Services	do.	319.0	337.3	353.7	+4.9
Government	do.	287.1	298.2	305.4	+2.4
Total nonagricultural employment	do.	[1]1,798.9	1,887.0	[1]1,964.8	+4.1
Personal income:					
Total	millions	$31,468	$35,241	$39,738	+12.8
Per capita		$6,776	$7,532	$8,419	+11.8
Construction activity:					
Number of private and public residential units authorized		41,296	[2]37,651	25,999	-30.9
Value of nonresidential construction	millions	$370.6	$419.4	$554.1	+32.1
Value of State road contract awards	do.	$30.0	$129.0	$148.5	+15.1
Shipments of portland and masonry cement to and within the State	thousand short tons	1,817	1,952	1,830	-6.2
Nonfuel mineral production value:					
Total crude mineral value	millions	$150.1	$159.2	$179.7	+12.8
Value per capita, resident population		$32	$34	$38	+11.8
Value per square mile		$2,674	$2,836	$3,200	+12.8

[p] Preliminary.
[1] Data do not add to total shown because of independent rounding.
[2] Series revised in 1978; data not comparable with those of prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

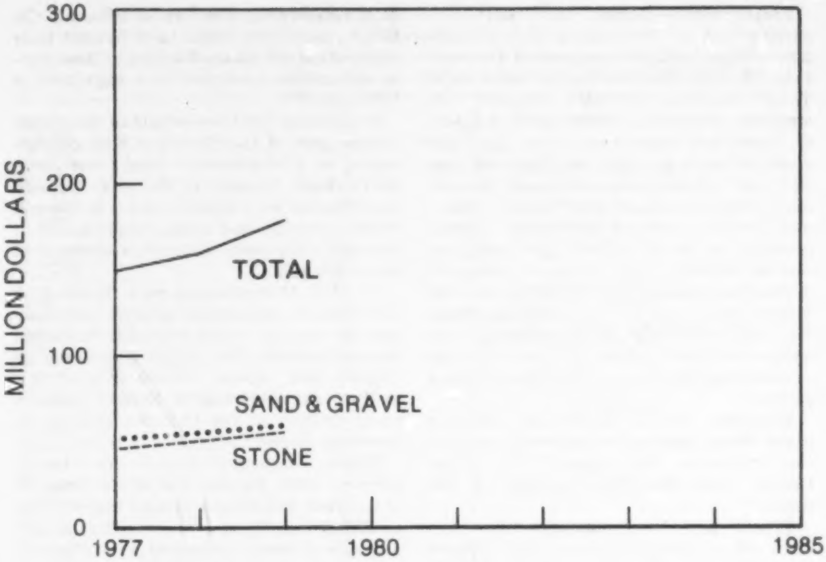

Figure 1.—Value of sand and gravel, and stone, and total value of nonfuel mineral production in Wisconsin.

In summer of 1978, the Wisconsin Counties Mineral Resources Association recommended to its 26 members that the mining moratoriums that most counties had enacted in 1977 be lifted. These moratoriums resulted from disagreements over the 1977 State mining tax law and how the local governments were to share the taxes the State was levying on mine proceeds. Later, a compromise effected by the State legislators enabled local governments to receive a larger tax share.

In 1979, the last producing zinc mine in Wisconsin was shut down. Eagle-Picher Industries, Inc., terminated production at the Shullsburg Mine in Lafayette County because of depressed market prices and U.S. Environmental Protection Agency rules regarding quality requirements for water pumped out of the mines. The requirements put an excessive burden upon the company, because ambient water quality in the area already violates standards due to the extensive presence of metals in the surrounding terrain. Eagle-Picher had ended production at the Bear Hole Mine in early 1978.

Mining has taken place in southwestern Wisconsin for the past 125 years; now that the mines are filling with water, dewatering costs may become prohibitive, even though zinc prices may rise in the future.

Legislation and Government Programs.—The 1977 State legislative session maintained a high-level mining-related activity in 1978. Five major laws pertaining to mining were enacted in 1978, and two other bills were drafted for further action in 1979.

Chapter 253—Mineral Leases.—This act established a 10-year limit on exploration leases and a 50-year limit on mining leases. The act also provides for a right-to-cancel period, mandatory public recording of leases, and full financial disclosure of all lease terms.

Chapter 377—Solid Waste Disposal.—This act identified mine waste as solid waste and mandated creation of special administrative rules for its management. A Metallic Mining Council was also created to advise the Department of Natural Resources on its mining regulatory activity.

Chapter 420—Mine Water Withdrawals.— This act regulates the withdrawal of both surface and underground water by mining operations. It repealed an earlier law that had given mining companies almost unlimited power to convey water over lands owned by others.

Chapter 421—Metal-Mine Reclamation.—This act revised Wisconsin's metal-mine reclamation laws and mandated rules to regulate exploration, prospecting (bulk sampling), and mining. The rules, promulgated in 1978, are known as chapters NR 130, NR 131, and NR 132 of the Wisconsin Administrative Code.

Chapter 422—Geological Information.—This act requires submittal of certain drillhole data and samples to the State Geologist, with some provision for confidentiality of the information.

NR 340, part of Wisconsin's administrative code, was finalized in November 1978. The rules codified existing standards and procedures in the Department of Natural Resources relative to sand, gravel, and rock excavation and reclamation activities along navigable waterways.

Legislative study committees in 1978 and 1979 focused on nonmetallic mining and long-term liability for metallic mining companies. The nonmetallic study group initiated hearings in late 1978 and continued deliberations into 1979, approving a comprehensive draft bill that would grant counties broad regulatory powers. Also in 1979, a draft of legislative provisions for long-term liability for metallic mining companies was approved. Both draft bills are expected to be submitted for formal legislative action in 1980.

The Metallic Mining Council began a long process of hearings and technical information sessions leading to the promulgation of mine waste disposal rules, expected in May 1980. The Council (an advisory organization for the State Department of Natural Resources) is composed of a cross section of mining, environmental, legal, and technical interest groups.

The Mining Investment and Local Impact Fund was created by Chapter 31 Laws of 1977. The fund was set up so that revenues generated by the net proceeds occupation tax on metal mining could be distributed to local governments. The State legislature provided the Mining Impact Board, which is responsible for administering the fund, with $2 million to handle initial requests for assistance from local communities. In 1978, the newly formed Board ruled that Indian tribal councils would be considered the same as county and municipal governments in the distribution of funds to offset mining impacts. In June 1979, the Board made its first grants to communities after adopting an emergency plan allowing it to respond to requests for assistance related to health, safety, and general welfare. Approximately $65,500 was distributed to various units of local government for providing legal fees, developing zoning ordinances, and installing fencing for an abandoned iron mine area.

In 1978, the Geological and Natural History Survey, University of Wisconsin-Extension, initiated a long-term bedrock geology mapping program focusing on the Precambrian terrain in northern Wisconsin. In final form the maps will be at a scale of 1:250,000 and will utilize ground observations, gravity, and aeromagnetic information where available, together with information collected under provisions of Chapter 422, Laws of 1977. Although current efforts are directed primarily to northern Wisconsin, the entire State will be mapped by 1987.

In 1978, the Survey created a Mineral Resources and Mining Information Section which acts as liaison with State, Federal, and local governments concerning mineral resources and mining issues. The Section's program is designed to establish the Survey as a primary source of information on the State's mineral resources and mineral industries.

During May 1978, the Wisconsin Coastal Zone Management Program received Federal approval and was awarded approximately $1.4 million to begin implementation. The program was developed after 3 years of public discussion and study.

As part of the State program, a ports demonstration project was initiated that involved the State Department of Business Development and the ports of Superior and Milwaukee. The objective was to develop a joint State-local marketing program that would increase import and export cargoes (including mineral commodities) and provide increased industrial investment and employment opportunities.

The Upper Great Lakes Regional Commission (UGLRC) announced several grants for mineral-related projects in 1978 and 1979. Grants were awarded for the production of a documentary film on mining and the development of a mine training program at Nicolet College and Technical Institute in Rhinelander. Also, grants were awarded for two studies: (1) An investiga-

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tion of the quality and temperature of water in two abandoned iron mine shafts in north-central Wisconsin for possible industrial use, and (2) an investigation of the feasibility of locating a polystyrene insulation plant in Superior.

An ongoing study funded by UGLRC is investigating the economics of removing pyrite from mining wastes and converting it into marketable sulfur and iron compounds. In addition, the study will investigate potential markets for these products and regulatory policies, taxes, and subsidies that may persuade mining firms to process pyrite tailings.

The Federal Bureau of Mines and the U.S. Geological Survey (USGS) conduct mineral surveys of lands under consideration for wilderness designation. Once an area is designated by the U.S. Congress as wilderness, mineral extraction is not allowed. Mineral surveys are required by the Wilderness Act (Public Law 88-577, September 3, 1964) and by Public Law 93-622, January 3, 1975, which expanded coverage of the 1964 act to include areas in the Eastern States.

Results of mineral surveys are published by the USGS in its Bulletin series. A report on the Round Lake Wilderness Study Area created by Public Law 93-622 was released as a USGS open-file report in 1979 (OFR 79-703).

In 1977, the Forest Service of the U.S. Department of Agriculture initiated its Roadless Area Review and Evaluation (RARE II) program which took a second look at the resource potential of roadless areas suitable for wilderness use. By the end of 1978, the Forest Service had identified 23 areas in the Chequamegon and Nicolet National Forests as suitable for evaluation.

In Chequamegon National Forest, 11 areas comprising 58,846 acres were evaluated for wilderness characteristics. Of these, four areas (19,306 acres) were nominated for wilderness status. Twelve areas comprising 55,803 acres were evaluated in the Nicolet National Forest. Two areas, Blackjack Springs (5,886 acres) and Whisker Lake (7,428 acres), were designated as wilderness by the U.S. Congress in October 1978. Three more areas (22,720 acres) have been nominated for wilderness status. The U.S. Congress will act on these nominated areas in the future.

The Lakes State Office of the Bureau of Land Management initiated a program to develop maps of the surface and mineral estate on lands owned by the Federal Government in States under its jurisdiction as part of the Bureauwide program covering all States. Initial efforts were directed toward completing maps of Minnesota. The first maps of Wisconsin areas will be released in mid-1980.

During 1978 and 1979, the Federal Bureau of Mines signed several contractual agreements with industrial firms, educational institutions, and consulting firms in Wisconsin to conduct basic research on mining equipment and applications, mine safety, and mineral resources. Funding for these studies was approximately $1.1 million in fiscal years 1978 and 1979. Two contracts apply directly to Wisconsin.

Mervin C. Nelson and Associates, Milwaukee, was awarded a contract to determine the cost and time of the tasks associated with the premining stage for copper mining in the northern highlands of Wisconsin. Results are expected to be released in 1980.

The University of Wisconsin-Extension, Geological and Natural History Survey, contracted to provide 4,000 locations of mines, mills, prospects, and mineral occurrences in the State to enter into the Bureau of Mines Mineral Industry Location System. Results will be submitted to the Bureau in 1980.

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Abrasive Materials.—Baraboo Quartzite Co., Inc., continued to mine a quartzite deposit near Baraboo, in Sauk County, to produce deburring and burnishing media. Quarried on multiple benches, the stone was crushed, milled, and screened to produce about 15 different sizes of abrasives ranging from 3/16 inches by 1/8 inch to 1-3/4 inches by 1-1/4 inches. The finished product was usually sold in 100-pound bags for use in metal-stamping plants. Compared with 1977 output, production slightly increased in 1978 and then declined in 1979. Value increased about 14% between 1977 and 1979.

Cement.—Three firms produced cement in the State in 1978 and 1979. Medusa Cement Co., a subsidiary of Medusa Corp., continued to be the State's only producer of white cement (type II, waterproof, and other portland cements) and masonry cement at its plant in Manitowoc County. The other two, Universal Atlas Cement Div. of United States Steel Corp., in Milwaukee, and the Huron Cement Co. (National Gypsum Co.) in Superior, operated grinding facilities. Both produced various types of portland cement from partially manufactured cement materials shipped to Wisconsin from facilities outside the State. National Gypsum's Cement Division has a fleet of six self-unloading bulk cargo ships that distribute to markets in the Great Lakes area.

In 1978, Huron Cement completed an approximately $1 million program of modifications and additions to its facilities in Superior and Duluth. At Superior, where the firm operated a cement clinker grinding mill with storage and distribution facilities, the rail bulk cement loading system was revamped, and improved air pollution control equipment was installed. Clinker and cement were shipped to this mill from National Gypsum's plant in Alpena, Mich.

Spot shortages of cement occurred in the State toward the end of 1978, reflecting a nationwide pattern of increased demand and declining cement production capacity. Plants in Wisconsin do not have the capacity to manufacture the quantity of cement consumed in the State.

Most of the cement produced in the State was shipped to consumers in bulk containers by truck. Customers included building materials dealers, concrete product manufacturers, ready-mix companies, and highway contractors.

Clays.—Oakfield Shale Brick & Tile Co. continued as the only commercial producer of clay and shale within the State during 1978 and 1979. Common clay and shale were produced from a deposit near Oakfield, in Fond du Lac County, and were used in the company's nearby brick plant to manufacture common and face brick. Production in 1979 remained essentially the same as that in 1978.

Clay was also mined from a site owned by Eau Claire County, south of the city of Eau Claire, for the purpose of lining a new city landfill. The Eau Claire County Board agreed to sell the city up to 160,000 cubic yards of clay for $40,000. Clay mined near Menomonie, in Dunn County, was also used for the project.

Lime.—Both quick and hydrated lime were produced by three companies operating five plants in the State.

The Western Lime & Cement Co. produced lime at plants in Green Bay in Brown County, Knowles in Dodge County, and Eden in Fond du Lac County. Most of the lime produced was shipped to paper mills, tanneries, water treatment plants, steel mills, food processors, and the construction industry. A new hydrator was put into operation at the Eden plant in 1978.

Rockwell Lime Co. operated a plant at Manitowoc, in Manitowoc County, and CLM Corp. produced at a plant in Superior, in Douglas County. Because of uncertainty over the availability of oil and gas, CLM Corp. reactivated coal-burning equipment at its plant. A new conveyor system was installed to move stockpiled coal to holding hoppers, to be crushed and sized for use in the rotary kilns. Lime from the operation was sold to customers in Wisconsin, Michigan, North and South Dakota, Iowa, Illinois, and Canada.

Peat.—Waukesha County was the center of a peat production within the State. Three firms—Bogda's Top Soil & Excavation Co., Certified Peat & Sod, Inc., and Demilco, Inc., a division of Nitragin Sales Corp.—produced humus and moss peat for horticultural purposes. Sold in bulk and packaged form, the peat was used for general soil improvement, packing for flowers, plants, and shrubs, and seed inoculant.

A unique experiment utilizing peat was initiated at Drummond, a small town bordering the Chequamegon National Forest, in Bayfield County. A peat bog with a natural clay lining is being used to filter secondary effluent from the town's new sewage treatment facility before release to adjoining waters. Results from this study may encourage other communities with sewage disposal problems to use peat for protection of high quality waters.

Perlite.—Two plants produced expanded perlite from crude perlite mined outside the State. W. R. Grace & Co. operated one in Milwaukee, Milwaukee County, and Midwest Perlite Co. operated one in Appleton, Outagamie County. Primary uses of the expanded product were for horticultural aggregate, plaster and concrete aggregate, masonry and cavity fill insulation, and fillers.

Production of expanded perlite decreased almost 35% from 1977 through 1979, mainly because of competition from other materials. As soil conditioner, vermiculite is easier and more practical to use; it also possesses

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as good, or better, fireproofing, insulating, and acoustical properties. Unit prices of the two products were about equal in 1978. Demand for polystyrene products as cavity fillers, for insulation, and for acoustical uses has also cut into the sales of perlite.

Sand and Gravel.—Sand and gravel continued to be the major commodity mined in Wisconsin in terms of tonnage and value in 1978 and 1979. The largest amount of production occurred in the southeastern part of the State, near the large population centers. Trucking continued to be the major means of transporting sand and gravel products to market.

Table 4.—Wisconsin: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	7,371	$14,447	$1.96	7,935	$15,179	$1.91	9,061	$17,365	$1.92
Plaster and gunite sands	NA	NA	NA	432	650	1.51	513	899	1.75
Concrete products	703	1,279	1.82	368	759	2.07	472	1,000	2.12
Asphaltic concrete	4,555	7,589	1.67	5,274	8,256	1.57	5,393	8,903	1.65
Roadbase and coverings	11,002	16,675	1.52	11,519	16,947	1.47	10,892	16,322	1.50
Fill	3,798	4,383	1.15	3,216	4,309	1.34	4,078	5,609	1.38
Snow and ice control	NA	NA	NA	103	127	1.23	144	208	1.44
Railroad ballast	W	W	W	8	18	2.25	6	13	2.19
Other uses	730	803	1.10	398	477	1,20	320	505	1.58
Total[1] or average	28,159	45,176	1.60	29,253	46,721	1.60	30,879	50,824	1.65

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."

[1] Data may not add to totals shown because of independent rounding.

Table 5.—Wisconsin: Sand and gravel sold or used by producers, by use

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Construction:									
Sand	9,296	$15,194	$1.63	9,719	$16,391	$1.69	9,650	$17,219	$1.78
Gravel	18,863	29,982	1.59	19,533	30,330	1.55	21,229	33,605	1.58
Total[1] or average	28,159	45,176	1.60	29,253	46,721	1.60	30,879	50,824	1.65
Industrial:									
Sand	W	W	W	1,222	6,291	5.15	1,166	7,752	6.65
Gravel	W	W	W	--	--	--	--	--	--
Total or average	866	5,034	5.81	1,222	6,291	5.15	1,166	7,752	6.65
Grand total[1] or average	29,025	50,210	1.73	30,474	53,012	1.74	32,046	58,576	1.83

W Withheld to avoid disclosing company proprietary data; included in "Total."

[1] Data may not add to totals shown because of independent rounding.

Approximately 95% of the sand and gravel mined in the State was used for construction purposes, such as roadbase material, concrete aggregate, concrete products, plaster and gunite sand, snow and ice control, aggregate for asphalt mixes, railroad ballast, and fill.

Industrial-quality sand was produced in six counties and was used mainly for glass manufacture, molding and foundry sand, sandblasting, and other purposes. A new industrial sand operation began shipping its product in 1979. The mine, operated by Badger Mining Corp., is near Taylor in Jackson County. About one-half of the mine's production is expected to be utilized by the oil industry as a medium for fracturing oil wells.

Stone.—Following sand and gravel, stone was the second-leading mineral commodity mined in Wisconsin during 1978 and 1979. In 1978, production was reported by 138 companies and local government agencies operating 352 quarries in 47 of the State's 72 counties. Marathon County led the State in total production at approximately 3.4 million tons, and five other counties had production in excess of 1 million tons. Dane County had the largest number of operating quarries. Most of the stone produced in the State was transported by truck.

Crushed and broken stone exceeded dimension stone in terms of quantity and value. Limestone continued to be the major rock type mined, followed by granite, sandstone, and traprock. Most crushed and broken stone was used as aggregate, roadbase material, or for other construction purposes.

In 1978, dimension stone was produced from 31 quarries in 7 counties. Limestone was quarried in Calumet, Dane, Fond du Lac, Manitowoc, and Waukesha Counties. Granite was quarried in Marathon and Waushara Counties, and some sandstone was produced in Marathon County. The largest amount of dimension stone was produced in Waukesha County.

Table 6.—Wisconsin: Dimension stone[1] sold or used by producers, by use

Use	1977			1978			1979		
	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)	Short tons	Cubic feet (thousands)	Value (thousands)
Rough stone:									
Irregular-shaped stone	5,689	71	$140	1,168	15	$21	898	12	$21
Rubble	[r]23,143	289	430	17,791	222	304	16,524	208	284
Monumental	3,017	19	383	3,084	20	418	2,288	15	350
Flagging	7,160	90	192	5,752	72	159	6,791	85	187
Dressed stone:									
Cut	1,933	24	166	3,087	38	299	2,585	32	282
Sawed	2,411	29	128	2,466	29	132	1,163	15	66
House stone veneer	20,820	260	1,005	19,347	242	902	15,162	190	739
Construction	3,326	42	84	1,930	24	54	W	W	W
Monumental	2,961	32	2,252	2,714	31	2,179	2,503	28	2,157
Curbing	W	W	3	W	W	W	W	W	W
Other uses[2]	2,681	33	39	6,337	79	95	6,403	80	119
Total[3]	73,141	889	4,821	63,678	773	4,562	54,317	665	4,204

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."
[1]Includes limestone, granite, and sandstone.
[2]Includes rough blocks, dressed flagging, and other uses (1978-79).
[3]Data may not add to totals shown because of independent rounding.

Table 7.—Wisconsin: Crushed stone[1] sold or used by producers, by use

(Thousand short tons and thousand dollars)

Use	1977		1978		1979	
	Quantity	Value	Quantity	Value	Quantity	Value
Agricultural limestone	1,229	3,200	969	2,585	929	2,870
Concrete aggregate	[r]1,456	[r]2,689	1,494	2,853	2,102	4,716
Bituminous aggregate	1,208	2,211	3,220	4,297	1,544	3,728
Macadam aggregate	551	983	510	1,000	W	W
Dense-graded roadbase stone	6,498	[r]10,048	5,734	9,299	8,135	14,464
Surface treatment aggregate	2,214	4,166	1,932	3,625	1,760	3,814
Other construction aggregate and roadstone	5,842	9,915	7,043	13,300	5,912	11,544
Riprap and jetty stone	192	738	223	1,015	469	2,153
Railroad ballast	1,305	3,170	1,357	3,460	915	2,781
Filter stone	77	142	142	257	79	248
Manufactured fine aggregate (stone sand)	44	97	149	245	76	174
Flux stone	15	24	15	25	13	26
Roofing granules	1,256	3,850	1,389	4,329	1,435	4,966
Bedding material	--	--	5	8	--	--
Drain fields	--	--	2	3	--	--
Fill	87	137	W	W	W	W
Other uses[2]	268	727	203	690	556	1,320
Total[3]	22,241	42,097	24,385	46,990	23,924	52,804

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Other uses."
[1]Includes limestone, granite, sandstone, traprock, and miscellaneous stone (1977).
[2]Includes stone used in lime manufacture, abrasives (1977), terrazzo and exposed aggregate (1978), other fillers (1979), and other uses.
[3]Data may not add to totals shown because of independent rounding.

Sulfur (Recovered Elemental).—Murphy Oil Corp.'s refinery in Superior continued to produce sulfur as a byproduct during 1978 and 1979. Approximately 3,000 metric tons of sulfur was shipped by rail during this period to a consumer in central Minnesota.

Vermiculite.—Two plants produced exfoliated vermiculite from crude ore shipped from outside the State during 1978 and 1979. Koos, Inc., operated a plant in Milwaukee County. The exfoliated product was used for soil conditioning, fertilizer mixes, loose fill and block insulation, and concrete and plaster aggregate.

METALS

Iron Ore.—Jackson County Iron Co., a wholly owned subsidiary of Inland Steel Co., continued to be the only producer of iron ore in the State during 1978 and 1979. The multiple-bench open pit mine and plant facilities are located about 5 miles east of Black River Falls, in Jackson County. Taconite pellets produced at the plant were shipped 224 miles by rail to Inland Steel's Indiana Harbor Works in East Chicago, Ind.

In late 1978, Cleveland-Cliffs Iron Co., Cleveland, Ohio, announced that it had purchased mineral rights to land in Ashland and Iron Counties from Jones & Laughlin Steel Corp., Pittsburgh, Pa. The lands are in areas of an iron-bearing formation, and the acquisition was reported to be part of the firm's long-range policy to acquire reserves as they became available. The firm reported that it had no immediate plans for exploration or development of the lands involved in the transaction.

Record tonnages of taconite pellets were shipped from Burlington Northern, Inc.'s transshipment terminal on Allouez Bay in Douglas County in 1978 and 1979. The facility, which went onstream in mid-August 1977, was designed to accommodate increased production of pellets from taconite operations in the Mesabi Iron Range of Minnesota. Shipments of pellets were 12,414,000 and 13,675,000 long tons in calendar years 1978 and 1979, respectively.

Zinc—Copper.—Since 1968, three base metal massive sulfide discoveries have been announced in north-central Wisconsin. These are the Flambeau deposit in Rusk County, discovered by Kennecott Copper Corp. in 1968; the Pelican deposit in Oneida County, discovered by Noranda Exploration Co. in 1974; and the Crandon deposit in Forest County, discovered by Exxon Minerals Co., U.S.A., in 1976. Although mining of these properties had not commenced in 1979, potential remains for Wisconsin to become a major metallic-mineral-producing State.

in 1979, Kennecott Copper Corp. settled eight legal proceedings that had arisen out of its 1976 mine permit application for the Flambeau ore body. The settlement of several issues with environmental groups brought to an end Kennecott's attempts to keep its mine permit application in legal effect with the Department of Natural Resources. No time schedule or other plans for renewed permit applications have been announced. The Flambeau ore body was reported to contain 6 million tons of ore averaging approximately 4% copper, with lesser values of zinc. The deposit was proposed to be developed as an open pit operation, with subsequent underground development possible at a later date. Environmental monitoring continued on a reduced scale during 1978 and 1979 at the proposed mine site.

The Pelican deposit has remained essentially inactive since the fall of 1976, when drilling was completed and Noranda announced it would not presently pursue mine development. The deposit was reported to contain 2.3 million tons averaging 4.5% zinc and 1% copper. In the fall of 1978, Noranda closed its exploration office in Rhinelander, Wis. The firm has obtained a temporary restraining order in the Oneida County Circuit Court seeking to have Section 107.15 of the Wisconsin statutes, created by Chapter 422, Laws of 1977, declared unconstitional. This law requires the firm to file results of its exploration activities with the State Geologist. A trial date was set for early 1980.

The Crandon deposit, reported to contain at least 70 million tons of 5% zinc and 1% copper,is the largest ore body discovered to date. In early 1978, Exxon announced the purchase of 1,160 acres of land at the site of its discovery from Connor Forest Industries. The land is located in the towns of Nashville and Lincoln, and the purchase price was reported to be $2.32 million. The land was needed to make detailed engineering and environmental studies, to provide alternative plant sites as required by an environmental impact report, and to provide a buffer zone around the potential development area.

During 1978 and 1979, Exxon continued evaluating the deposit, with effort focusing on mine feasibility studies, environmental baseline data gathering, and refinement of information concerning ore body characteristics. A study was also begun on the possibility of separating iron pyrite from the rest of the tailings so that a greater percentage of the pyrite could be returned underground. Exploration and development drilling were completed with more than 200 holes drilled.

Zinc—Lead.—Eagle-Picher Industries, Inc., operated two mines in Lafayette County during 1978 and 1979 and was the sole producer of zinc in the State. Ore from the mines was processed at the Shullsburg Mill, just across the border in Illinois. Because of depressed market prices, the Bear Hole Mine was closed and put on pumps at the end of February 1978, and production at the Shullsburg Mine and Mill was reduced from three shifts to one. The Shullsburg Mine was finally closed on October 1, 1979, and pumping at both mines was discontinued.

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[1] State mineral specialist, Bureau of Mines, Pittsburgh, Pa.

[2] Assistant professor, Minerals Information, Geological and Natural History Survey of Wisconsin, Madison, Wis.

Table 8.—Principal producers

Commodity and company	Address	Type of activity	County
Abrasive stone:			
Baraboo Quartzite Co., Inc	Box 123 Baraboo, WI 53913	Quarry and plant	Sauk.
Cement:			
Medusa Cement Co., a division of Medusa Corp.	Box 5668 Cleveland, OH 44101	Dry process plant	Manitowoc.
National Gypsum Co., Huron Cement Div.	17515 West 9 Mile Rd. Southfield, MI 48075	Grinding plant only.	Douglas.
Universal Atlas Cement Div., United States Steel Corp.	600 Grant St. Pittsburgh, PA 15230	do	Milwaukee.
Clay and shale:			
Oakfield Shale Brick & Tile Co.	Box 337 Oakfield, WI 53065	Pit and plant	Fond du Lac.
Iron ore:			
Jackson County Iron Co., a subsidiary of Inland Steel Co.:			
Black River Falls	30 West Monroe St. Chicago, IL 60603	Mine, concentrator, agglomerator.	Jackson.
Iron oxide pigments, finished:			
Delta Color & Supply Co	1050 East Bay St. Milwaukee, WI 53217	Plant	Milwaukee.
Lime:			
CLM Corp	12th Ave. West & Waterfront Duluth, MN 55802	Quicklime and hydrated lime.	Douglas.
Rockwell Lime Co	Route 2, Box 124 Manitowoc, WI 54220	do	Manitowoc.
The Western Lime & Cement Co	Box 2076 Milwaukee, WI 53201		
Green Bay plant		do	Brown.
Knowles plant		do	Dodge.
Eden plant		do	Fond du Lac.
Peat:			
Bugda's Top Soil & Excavating Co.	12600 West Cleveland Ave. New Berlin, WI 53151	Bog and processing plant.	Waukesha.
Certified Peat & Sod, Inc	19000 West Lincoln Ave. New Berlin, WI 53151	do	Do.
Demilco, Inc., a division of Nitragin Sales Corp.	3101 West Custer Ave. Milwaukee, WI 53209	do	Do.
Perlite, expanded:			
Construction Products Div., W. R. Grace & Co.	62 Whittemore Ave. Cambridge, MA 02140	Processing plant	Milwaukee.
Midwest Perlite Co	542 West Linberg Appleton, WI 54911	do	Outagamie.
Sand and gravel:			
Construction sand and gravel:			
Genesee Aggregate Corp	10919 West Bluemond Rd. Milwaukee, WI 53226	Pit and plant	Waukesha.
Janesville Sand & Gravel Co	Box 427 Janesville, WI 53545	Pits and plants	Rock.
Johnson Sand & Gravel, Inc	22750 Bluemond Rd. Waukesha, WI 53186	do	Waukesha.
Edward Kraemer & Sons, Inc	Plain, WI 53577	do	Barron, Chippewa, Eau Claire, Ozaukee.
McHenry Sand & Gravel Co., Inc	Box 511 McHenry, IL 60050	Pit and plant	Kenosha.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Sand and gravel —Continued			
Construction sand and gravel —Continued			
State Sand & Gravel Co	10833 West Watertown Plank Rd. Milwaukee, WI 53226	Pits and plants	Waukesha.
Tews Lime & Cement Co	6200 West Center St. Milwaukee, WI 53210	Pit and plant	Do.
Vulcan Materials Co., Midwest Div.	Box 6 Countryside, IL 60525	do	Do.
Wolf Construction Co., Inc	612 North Sawyer Rd. Dousman, WI 53118	Pits and plants	Dane, Dodge, Jefferson, Waukesha.
Industrial sand:			
Chier Industrial Sand Co	Box 288 Berlin, WI 54923	Pit and plant	Green Lake and Winnebago.
Martin Marietta Corp., Industrial Sand Div	110 East Main St. Rockton, IL 61072	do	Columbia.
Stone:			
Granite:			
Anderson Bros. & Johnson Co	Box 26 Wausau, WI 54401	Quarries and plant	Marathon.
Beilke Granite Co	1622 Mathie St. Wausau, WI 54401	Quarry and plant	Do.
Ben Gottschalk, Inc	Route 1 Mosinee, WI 54455	Quarries and plant	Do.
Ladick & Belanger Granite Co	do	Quarry and plant	Do.
Lake Wausau Granite Co	Box 397 Wausau, WI 54401	do	Do.
Limestone and dolomite:			
Courtney & Plummer, Inc	Box 767 Neenah, WI 54956	Quarries and plant	Calumet and Winnebago.
Daanen & Janssen	Box 127 De Pere, WI 54115	do	Brown.
Halquist Stone Co., Inc	N52 W23564 Lisbon Rd. Sussex, WI 53089	do	Waukesha.
Edward Kraemer & Sons, Inc	Plain, WI 53577	Quarries and plants.	Buffalo, Crawford, Dunn, Juneau, La Crosse, Marquette, Pepin, Pierce, Richland, St. Croix, Sauk, Trempealeau, Vernon.
Landwehr Materials, Inc	Route 2 Appleton, WI 54911	Quarry and plant	Outagamie.
Madison Stone Co., Inc	5813 U.S. Highway 51 Madison, WI 53704	Quarries and plants	Dane.
Oakfield Stone Co	Box 221 Oakfield, WI 53065	Quarry and plants	Fond du Lac.
Arthur Overgaard Co	Box 87 Elroy, WI 53929	Quarries and plants	Buffalo, Juneau, La Crosse, Monroe.
Valders Lime & Stone Co	Box 35 Valders, WI 54245	Quarry and plant	Manitowoc.
Vulcan Materials Co., Midwest Div.	Box 6 Countryside, IL 60525	Quarries and plants	Milwaukee, Racine, Waukesha, Winnebago.
G. A. Watson	Barneveld, WI 53507	do	Iowa and Lafayette.
Waukesha Lime & Stone Co	Route 5, Highway 164 Waukesha, WI 53186	Quarry and plants	Waukesha.
G. Wendtlandt, Inc	Mineral Point, WI 53565	Quarries and plant	Grant, Iowa, Lafayette.
Wilbur Lime Products	544 East 6th St. Trempealeau, WI 54661	Quarries and plants	Buffalo, Pepin, Trempealeau.
Sandstone and quartzite:			
Foley Bros., Inc	Rock Springs, WI 53961	Quarry and plant	Sauk.
Minnesota Mining & Manufacturing Co.	3M Center St. Paul, MN 55101	Quarries and plant	Marathon.
Traprock (basalt):			
Bryan Dresser Trap Rock, Inc	3750 Washington Ave. North Minneapolis, MN 55412	Quarry and plants	Polk.
GAF Corp	Box 630 Pembine, WI 54156	Quarry and plant	Marinette.
Sulfur, recovered elemental:			
Murphy Oil Corp	Box 2066 Superior, WI 54880	Byproduct sulfur recovery plant.	Douglas.
Vermiculite, exfoliated:			
Construction Products Div., W. R. Grace & Co.	62 Whittemore Ave. Cambridge, MA 02140	Processing plant	Milwaukee.

Table 8.—Principal producers —Continued

Commodity and company	Address	Type of activity	County
Vermiculite, exfoliated —Continued			
Koos, Inc.	4500 13th Ct. Kenosha, WI 51340	Processing plant	Kenosha.
Zinc and Lead:			
Eagle-Picher Industries, Inc	Box 406 Galena, IL 61036		
Bear Hole		Mine	Lafayette.
Shullsburg		Mine and mill	Do.

Free Public Library, Newark, N.J.

The Mineral Industry of Wyoming

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Wyoming Geological Survey for collecting information on all nonfuel minerals.

By Karl E. Starch[1]

The value of nonfuel mineral production in Wyoming was $493 million in 1978 and $590 million in 1979. With about 3.5% of the total value of nonfuel minerals produced nationwide, Wyoming ranked ninth among the States in nonfuel mineral production in 1978 and 14th in 1979. Twelve nonfuel minerals were produced in the State during the biennium, 11 nonmetalics, and 1 metal. Sodium carbonate (trona) was the most important nonfuel mineral produced in terms of value, followed at considerable distance by bentonite and iron ore. These three commodities combined accounted for more than 90% of the value of all nonfuel minerals produced in Wyoming in 1978-79.

Table 1.—Nonfuel mineral production in Wyoming[1]

Mineral	1977		1978		1979	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value (thousands)
Clays thousand short tons	2,966	$48,369	3,632	$66,975	3,471	$75,096
Gem stones	NA	200	NA	200	NA	200
Gypsum thousand short tons	356	2,571	370	2,995	366	3,100
Pumice do.	--	--	7	W	--	--
Sand and gravel do.	5,084	11,026	5,101	11,240	[2]5,265	[2]11,419
Stone do.	[3]2,434	[3]7,585	[3]2,661	[3]8,037	5,013	15,634
Combined value of cement, feldspar, iron ore, lime, phosphate rock, sodium carbonate (natural), sand and gravel (industrial, 1979), stone (dimension 1977-78), and values indicated by symbol W	XX	372,693	XX	403,622	XX	484,727
Total	XX	442,444	XX	493,069	XX	590,176

NA Not available. W Withheld to avoid disclosing company proprietary data; value included in "Combined value" figure. XX Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes industrial sand and gravel; value included in "Combined value" figure.

[3] Excludes dimension stone; value included in "Combined value" figure.

Table 2.—Value of nonfuel mineral production in Wyoming, by county[1]

(Thousands)

County	1977	1978	Minerals produced in 1978 in order of value
Albany	$9,110	W	Cement, sand and gravel, stone, clays, gypsum.
Big Horn	18,451	W	Clays, gypsum, sand and gravel, lime.
Campbell	W	W	Sand and gravel, pumice.
Carbon	1,226	$1,000	Sand and gravel.
Converse	165	252	Do.
Crook	W	W	Clays, stone.
Fremont	35,364	32,076	Iron ore, sand and gravel, feldspar.
Goshen	W	W	Lime, sand and gravel.
Johnson	W	W	Clays, sand and gravel.
Laramie	W	W	Stone, sand and gravel.
Lincoln	W	W	Phosphate rock, sand and gravel, stone.
Natrona	1,609	1,853	Sand and gravel, clays.
Park	W	2,202	Gypsum, sand and gravel.
Platte	W	W	Iron ore, stone, sand and gravel.
Sheridan	159	W	Sand and gravel.
Sublette	W	W	Stone, sand and gravel.
Sweetwater	W	W	Sodium carbonate, sand and gravel.
Teton	W	W	Sand and gravel, stone.
Uinta	W	W	Sand and gravel, clays, stone.
Washakie	W	W	Clays, lime, sand and gravel.
Weston	W	W	Clays, sand and gravel.
Undistributed[2]	376,364	455,688	
Total[3]	442,444	493,069	

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."

[1] Hot Springs and Niobrara Counties are not listed because no nonfuel mineral production was reported.

[2] Includes gem stones and values indicated by symbol W.

[3] Data may not add to totals shown because of independent rounding.

Table 3.—Indicators of Wyoming business activity

	1977	1978	1979[p]	1978-79 percent change
Employment and labor force, annual average:				
Total civilian labor force ... thousands	193.0	209.0	223.0	+6.7
Unemployment ... do	7.0	7.0	6.0	-14.3
Employment (nonagricultural):				
Mining[1] ... do	25.3	29.2	32.7	+12.0
Manufacturing ... do	9.0	9.6	10.2	+6.2
Contract construction ... do	17.0	19.3	22.3	+15.5
Transportation and public utilities ... do	13.3	14.8	16.5	+11.5
Wholesale and retail trade ... do	38.1	41.9	45.2	+10.2
Finance, insurance, real estate ... do	5.7	6.4	7.1	+2.4
Services ... do	24.1	27.2	29.1	+7.0
Government ... do	38.0	39.1	39.6	+1.3
Total nonagricultural employment[1] ... do	170.5	[2]187.4	[2]202.9	+8.3
Personal income:				
Total ... millions	$3,077	$3,679	$4,346	+18.1
Per capita	$7,579	$8,678	$9,657	+11.2
Construction activity:				
Number of private and public residential units authorized	4,373	[3]5,137	5,295	+3.1
Value of nonresidential construction ... millions	$52.7	$53.4	$81.1	+51.9
Value of State road contract awards ... do	$70.0	$50.0	$41.7	-16.6
Shipments of portland and masonry cement to and within the State ... thousand short tons	394	389	466	+2.0
Nonfuel mineral production value:				
Total crude mineral value ... millions	$442.4	$493.1	$590.2	+19.7
Value per capita, resident population	$1,090	$1,163	$1,312	+12.8
Value per square mile	$4,519	$5,036	$6,027	+19.7

[p] Preliminary.

[1] Includes bituminous coal and oil and gas extraction.

[2] Data do not add to total shown because of independent rounding.

[3] Series revised in 1978, data not comparable with prior years.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

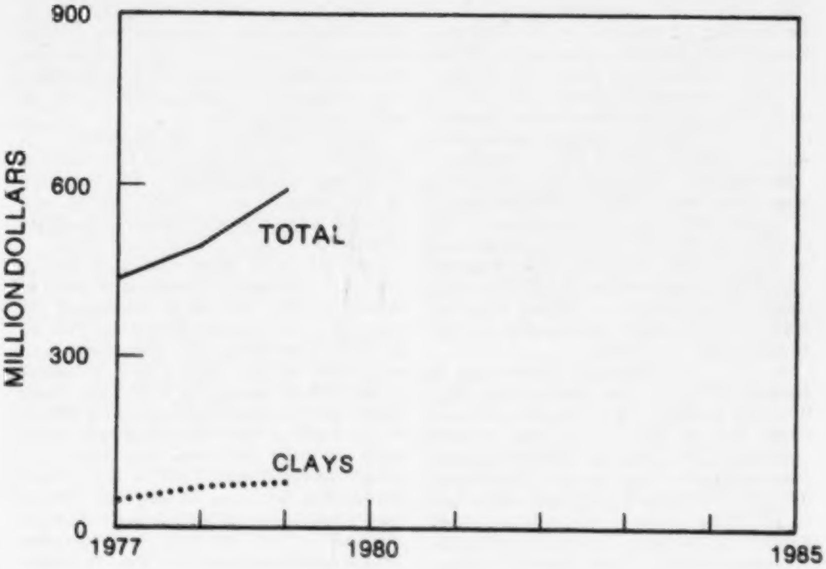

Figure 1.—Value of clays and total value of nonfuel mineral production in Wyoming.

Of Wyoming's 23 counties, only Niobrara and Hot Springs produced no nonfuel minerals. Sweetwater County, in the southwest corner of the State and the site of Wyoming's four large trona mines, was the most prolific source of nonfuel minerals. Wyoming, first nationally in trona (natural soda ash or sodium carbonate) production, was the world's largest producer of this commodity. Wyoming's enormous trona resource, the legacy of an Eocene Age lake and climate cycle, is unique in the world. The four mine-and-processing facilities are all within a few miles of each other, working essentially the same large interrelated deposit. This dominant position is likely to continue; the production trend is clearly upward with present producers expanding capacity at a rapid rate and a fifth mine and plant already under construction.

The State also ranked first in output of bentonite clay in 1978 and 1979, yielding 75% and 70% respectively, of the Nation's production in those years. Wyoming bentonite, of the high-sodium, high-swelling variety, is marketed worldwide.

Wyoming ranked fourth in the Nation in the production of iron ore in 1978 and fifth in 1979. Although this was only about 2-1/2% of total national output, it was important regionally and supplied an important part of the raw-material input to the only two steel plants between the Midwest and the Pacific coast.

The nonfuel mineral industry was relatively important in the Wyoming economy, with a per capita value of nearly $1,200 in 1978, and $1,400 in 1979, compared with approximately $88 per capita nationally. The Wyoming Employment Security Commission indicated 29,200 people were employed in mining in 1978 and 32,600 in 1979, 17% of the State work force in both years. Nationally, mining employed about 1% of the work force. Nonfuel-mineral-mining employment in Wyoming was about 6,500 in 1978, 7,100 in 1979, about 4% of total State employment as reported by the Wyoming Employment Security Commission. Trona mining provided about 60% of the nonfuel mining employment. Nearly 33% of the labor force in Sweetwater County, the leading county in nonfuel mineral production, was employed in nonfuel mineral mining.

Mining paid the highest average weekly wage in the State: $383 in 1978 and $426 in 1979, compared with a State average of $237 in 1978 and $265 in 1979. Trona mining paid an average $457 weekly in 1979, compared with $330 in construction and $168 in agriculture. High wages in mining attracted workers from other employment sectors and from out of the State.

In 1978, the Wyoming Department of Economic Planning and Development identified the mineral industry as the source of about 52% of the State's total assessed valuation of $3.75 billion; nonfuel minerals generated little more than 3%. The mineral industry directly paid a proportionate share of Wyoming taxes; if all mineral-related items were considered, 70% of Wyoming tax revenues devolved from mineral production. The big mineral-producing counties collected two-thirds of all the tax money in the State, with Sweetwater contributing 18%; Campbell, 15%; Fremont and Natrona, 7% each; and Carbon, Converse, and Park, 6% each. Total severance tax due in 1978 was $86 million and in 1979, $105 million; the nonfuel mineral sector contributed $5 million in 1978 and increased their share to $10 million in 1979. The mineral industry paid one-half of all ad valorem (property) taxes in the State or about $107 million in 1978 and $126 million in 1979; nonfuel minerals paid $8 million of these amounts both in 1978 and 1979.

The State Legislature passed no bills affecting the nonfuel mineral industry in 1978 or 1979. A bill to increase the severance tax on minerals introduced in the 1978-79 legislative session was defeated in committee. The Federal Land Policy and Management Act of 1976 required that all unpatented mining claims be recorded with the appropriate State Office of the Bureau of Land Management (BLM) by October 22, 1979. In Wyoming, approximately 190,000 claims were recorded by that deadline. The total number of mining claims in Wyoming was estimated at about 194,000, 80% of which are for uranium.

During the period, the Department of Chemical Engineering at the University of Wyoming was designated by the Secretary of the Interior as a State Mining and Mineral Resources and Research Institute pursuant to Title III of Public Law 95-87.

The Bureau of Mines continued its appraisal of the mineral potential of lands in Wyoming that are being considered for possible inclusion in the Wilderness System. In 1978, field work was undertaken and completed on the Scab Creek Primitive Area, a BLM-managed area of 9,380 acres; field work was also completed for the Snowy Range Study, a Forest Service area of 17,805 acres. In 1979, field work was begun and completed on Huston Park, a U.S. Forest Service Roadless Area Review and Evaluation (RARE II) site of 5,210 acres; field work was started for the Bridger Wilderness, 392,160 acres, and East and West Palisades RARE II areas, 135,840 acres, both administered by the U.S. Forest Service.

Special projects undertaken by the Geological Survey of Wyoming in 1978-79 included (1) an inventory of geologic hazards, such as subsidence, associated with active and abandoned mines throughout Wyoming; and (2) exploration for diamond-bearing kimberlite—examining several methods of prospecting for kimberlite, delineating newly discovered kimberlites, and testing for diamond occurrences. Three of the more important reports published by the Survey during the period were Exploration for Diamond-Bearing Kimberlite in Colorado and Wyoming: An Evaluation of Exploration Techniques (1979), Report of Investigations No. 19;[2] Wyoming Mineral Industry (1978), Public Information Circular, No. 8;[3] Wyoming Mines and Minerals Map (1979), Map Series No. 4.[4]

REVIEW BY NONFUEL MINERAL COMMODITIES

NONMETALS

Cement.—As in previous years, Monolith Portland Midwest Co. in Laramie, Albany County, was Wyoming's only cement producer. Output declined slightly in both 1978 and 1979 because of equipment problems. Masonry cement as well as portland cement was produced. Output was mostly general use cement, with some oil-well cement and high-sulfate-resistant cement also produced. Approximately 90% went to ready-mix companies; the balance went to concrete product manufacturers, other contractors, and building material dealers. It was shipped to consumers by contract truckers. The Wyoming State Inspector of Mines reported that about 83 hourly employees produced approximately 196,000 tons of cement at the Monolith plant in 1978, while 79 employees produced 192,000 tons in 1979. Installation of a new kiln and related equipment, begun in 1979, was expected to double kiln capacity and triple total output when completed in late 1980 or early 1981. The plant is equipped with an electrostatic precipitator designed to remove 99.7% of the particulate matter that would otherwise enter the atmosphere.

A cement shortage affected Wyoming during the 1978 summer construction season, as it did neighboring States. Governor Herschler appealed to President Carter and the Interstate Commerce Commission (ICC) for help in alleviating the situation. The ICC issued a 60-day order allowing truckers to haul cement into Wyoming without having to go through ICC licensing procedures. A State-operated cement plant in Rapid City, S.D., normally a source of cement for Wyoming, restricted shipments outside South Dakota during the shortage.

Clays.—Twelve companies produced clay in 8 of Wyoming's 23 counties during the biennium at 74 mining sites in 1978 and 85 sites in 1979. Ninety-nine percent of the clay was bentonite produced in Big Horn, Crook, Johnson, Natrona, Washakie, and Weston Counties. Crook and Big Horn were the sources of the largest output, with about two-thirds of the total production between them. Common clay, produced at four sites in Albany, Big Horn, and Uinta Counties, was used in manufacturing cement and common and face brick. Wyoming was first in the Nation in bentonite production in both years and second in the Nation, behind Georgia, in total clay production.

Wyoming produced about 70% of the Nation's bentonite. Bentonite ranked second in value of Wyoming's nonfuel mineral production. Sometimes called "Wyoming" or "western" bentonite, this clay is the swelling-sodium type because when wetted with water, it increases from 15 to 20 times its dry volume. The commodity is dried and packaged or shipped in carload lots as a finished product. Bentonite was first mined in 1888 on a ranch near Rock River, Wyo. During the 1978-79 biennium, it continued to be widely used as a binder in pelletizing iron ore (about 32% of Wyoming production), in drilling muds (21%), in foundry sands (17%), and in animal feeds (5%). It also was used in producing paint, paper, cosmetics, medicines, and in other applications where its sealant property was desirable. About 18% of Wyoming's production was exported to foreign markets.

Wyoming bentonite was produced by surface mining, which employed about 800 people in 1978 and 1,000 in 1979. Known reserves of usable bentonite in Wyoming have been estimated to be 75 to 90 million tons: 60% is on the western flank of the Big Horn Mountains; 20% in the Black Hills area; and 20% in the Kaycee area. Total resources may run into billions of tons. The American Colloid Co., with six mine sites in Big Horn, Crook, and Weston Counties and plants at Lovell and Upton, was the leading producer of bentonite in Wyoming in 1978-79. Kaycee Bentonite Corp. (Black Hills Bentonite Co.), the second largest producer, operated three mine sites in Johnson and Washakie Counties and plants at Casper and Worland. Other major producers were Dresser Minerals, a division of Dresser Industries, Inc., with 1 mine site in Big Horn County; NL Industries Inc., Baroid Division, 23 to 32 mine sites in Big Horn and Crook Counties; Wyo-Ben, 29 mine sites in Big Horn County; Youghiogheny and Ohio/Federal Bentonite, 4 mine sites in Crook and Weston Counties; and International Minerals and Chemical Corp. (IMC), 1 to 3 mine sites in Crook County. All produced about the same annual volume of bentonite.

Federal Bentonite, a division of Aurora Industries, Aurora, Ill., acquired the bentonite properties of the Youghiogheny and Ohio Coal Co. in Crook and Weston Counties. The company operated two integrated mining-and-processing facilities at Colony and Upton. In an expansion undertaken in 1978, IMC increased the fine-grinding capacity of its Colony plant by 35% to 40%, and doubled the granular production capacity. Granular production is accomplished by a hammer mill and screens; fine grinding (200 mesh and finer) is accomplished by high-side Raymond mills. The plant also produced a coarse semiprocessed "crushed and dried" product for bulk rail and ocean shipment. During the 1978-79 period, American Colloid, Dresser Minerals, IMC, Kaycee Bentonite, and Wyo-Ben converted their drying facilities from natural-gas-fired operations to coal, a development common throughout the industry. Kaycee Bentonite used solar drying as part of its process. Wyo-Ben began constructing a new 60-ton-per-hour drier, two-mill plant at Lucerne in June 1979, with an expected completion date of early 1980. It is expected to employ about 11 people.

Dresser Industries, Inc., submitted seven applications for bentonite patents covering 2,779 acres of land in Big Horn and Washakie Counties, containing an estimated 6.5 million tons of bentonite; the Bureau of Land Management approved the applications in 1978. The continuing question of whether bentonite is or is not a locatable mineral was further clarified in 1979 with the decision of a Federal hearing examiner. Basically, the examiner determined that bentonite possessing exceptional qualities or characteristics for use in industry is locatable; bentonites lacking such qualities are not. These findings are on appeal before the Department of the Interior Board of Land Appeals, which is expected to define and further clarify the standards applied by the Bureau of Land Management.

The severe 1978-79 winter along with a shortage of railroad cars and locomotives impeded production in these years.

Feldspar.—Modern Mining and Milling Co.'s Quien Sabe Mine and Mill, located north of Shoshoni in Fremont County, continued to be the sole producer in Wyoming's small feldspar industry in 1978-79. Production was shipped to Kansas City, Mo., for use in manufacturing detergents. Fremont County feldspar has been used in manufacturing abrasives, detergents, false teeth, glass, and soap.

Gem Stones.—Production of jade was reported from one quarry in Fremont County. Mineral Resources Development, Inc., held a mining permit for jade in two areas near Jeffrey City with reportedly 4 million pounds of jade blocked out for commercial production. Wyoming jade, the name given to an amphibole variety called "nephrite", is distinguished from the more valuable jadeite found in Burma, China, Mexico, and elsewhere. Gem-quality jade occurs in Wyoming in a 700-square-mile area of southern Fremont County and southwestern Natrona County, particularly along the Sweetwater River. Originating in Precambrian rocks, the jade was eroded and transported by streams where it is found along the present stream valleys. The areas where jade occurs have been so extensively picked over since it was first discovered in about 1936, that good-quality jade is becoming rare. Green serpentine and green quartzite found in the same area have sometimes been confused with jade. Lander and Riverton have been centers of jade collecting and lapidary work.

A particularly interesting development in gem stones in Wyoming was the discovery of microsized diamonds, 0.5 to 3.0 millimeters in diameter. The discovery was made in kimberlite diatremes (volcanic vents or pipes) in Albany County in 1975 on land owned by the State and the Union Pacific Railroad. Following the original discovery, the State halted land leasing pending development of regulations on diamond leases. Further assessment by the Wyoming Geological Survey and Rocky Mountain Energy Co. (RME), a subsidiary of Union Pacific, indicated there were enough of the microsized diamonds to warrant a broader quantitative evaluation by industry. An invitation for assessment proposals was submitted to more than two dozen mineral exploration companies. Following a June 30, 1978, deadline for proposals, the State and RME chose Cominco American, Inc., from among several companies to receive exclusive rights to explore for diamonds in a 2,900-acre-block of land south of Laramie near the Colorado border. If Cominco decides the area contains an economically recoverable amount of diamonds, it has a preferential right to lease the land involved. The Wyoming Geological Survey will continue to assess other areas in the State for kimberlite deposits. The stateline diamond discovery was only the second authenticated discovery of diamond-bearing kimberlite in the United States. Historically, only about 2% of the world's known kimberlite occurrences have proved to be economically minable.

Gypsum.—Crude gypsum was produced by Wyoming Construction Co., in Albany County; Georgia Pacific Corp., in Big Horn County; and the Celotex Corp., in Park County. Calcined gypsum was produced by Georgia Pacific and by Celotex in Big Horn and Park Counties. About 35 to 40 people were employed in gypsum production in Wyoming in 1978-79.

Lime.—The Great Western Sugar Co. and Holly Sugar Corp. produced lime in Big Horn, Goshen, and Washakie Counties for use in sugar refining. The volume of 1979 production increased about 8% over that of 1978, whereas value increased about 20%. Sugar-beet processing plants served included a number in northeastern Colorado, as well as in Wyoming.

Perlite.—Operating in Sweetwater County, the Western Perlite Corp. was the sole producer of perlite in Wyoming in 1978-79. Output decreased about 15% in the 2-year period.

Phosphate Rock.—Phosphate rock has been mined at only one site in Wyoming, Stauffer Chemical Co.'s Leefe Mine in Lincoln County. When this deposit was exhausted in 1976, the mine was permanently closed. The phosphate processing mill associated with the mine continued to be operated with ore imported from Idaho. About $4 million was invested in the mill to meet air-quality standards. The mill reportedly was operated at about 50% capacity in 1978-79, with about 60 to 70 employees, while mill operations were being adjusted to the Idaho ore. Reported output of the mill increased 25% in 1979 over that of 1978. Reclamation of the worked-out mine area proceeded through 1978-79.

Pumice.—The Morris Construction Co. produced about 7,500 short tons of pumice in 1978, in Campbell County. No pumice production had been recorded the previous year.

Sand and Gravel.—Sand and gravel was produced in 20 of Wyoming's 23 counties in 1978-79. Fremont, the leading county in output, had more than 20% of the State total in both years, followed by Natrona, Laramie, and Johnson Counties in 1978 and Sweetwater, Natrona, Johnson, and Laramie in 1979. Production was largely construction sand and gravel with no industrial sand and gravel output reported in 1978 and a very modest amount produced in 1979.

Production was by 49 companies mining at 61 sites in 1978 and 47 companies at 55 sites in 1979. The major use in 1978 was in asphaltic concrete, followed by concrete aggregate, and road base and covering; in 1979, the largest tonnage went into road base. The average price was $2.20 per ton in 1978 and $2.17 per ton in 1979, ranging from $1.44 ($1.40 in 1979) per ton for use as fill to $2.87 ($2.97 in 1979) per ton for use as concrete aggregate. About two-thirds of total output was gravel in 1978 increasing to four-fifths in 1979; almost the total output was transported to point of use by truck. About 75% of the sites mined were located on deposits containing less than 100,000 tons, but nearly 75% of output was from deposits greater than 100,000 tons. The largest deposit being mined contained nearly 1 million tons of material.

In a 1979 ruling on a case in which a private party owned the land surface and the Federal Government the mineral rights, a U.S. District Judge in Wyoming stated that gravel must be considered a mineral and protected under the Federal mineral rights to the land in question. In the past, gravel was often treated as part of the surface estate.

Table 4.—Wyoming: Construction sand and gravel sold or used, by major use category

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Concrete aggregate	1,111	$3,092	$2.78	1,270	$3,643	$2.87	1,207	$3,587	$2.97
Plaster and gunite sands	NA	NA	NA	18	47	2.62	26	99	3.75
Concrete products	293	555	1.89	W	W	2.10	W	W	2.10
Asphaltic concrete	1,049	2,695	2.57	1,684	3,770	2.24	1,189	2,553	2.15
Roadbase and coverings	1,788	3,501	1.96	1,182	2,646	2.24	2,346	4,336	1.85
Fill	782	1,032	1.32	733	1,058	1.44	440	618	1.40
Snow and ice control	NA	NA	NA	W	W	1.50	--	--	--
Railroad ballast	W	W	2.50	5	13	2.50	--	--	--
Other uses	51	150	2.94	30	64	2.13	57	227	3.98
Total[1] or average	5,084	11,026	2.17	5,101	11,240	2.20	5,265	11,419	2.17

NA Not available. W Withheld to avoid disclosing company proprietary data; included in "Other uses."
[1] Data may not add to totals shown because of independent rounding.

Table 5.—Wyoming: Construction sand and gravel sold or used by producers

Use	1977			1978			1979		
	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton	Quantity (thousand short tons)	Value (thousands)	Value per ton
Sand	1,242	$2,613	$2.10	1,552	$3,591	$2.31	1,106	$2,779	$2.51
Gravel	3,842	8,413	2.19	3,550	7,651	2.16	4,159	8,640	2.08
Total[1] or average	5,084	11,026	2.17	5,101	11,240	2.20	5,265	11,419	2.17

[1] Data may not add to totals shown because of independent rounding.

Table 6.—Wyoming: Construction sand and gravel sold or used by producers, by county

(Thousand short tons and thousand dollars)

County	1978			1979		
	Number of plants	Quantity	Value	Number of plants	Quantity	Value
Albany	5	232	805	2	W	W
Carbon	3	310	1,000	3	312	1,000
Converse	3	110	252	2	156	281
Fremont	2	1,199	1,736	2	1,117	1,313
Goshen	2	43	78	2	75	184
Johnson	2	516	1,571	2	510	1,679
Laramie	5	671	1,406	3	504	1,119
Lincoln	1	29	96	1	37	139
Natrona	2	706	1,376	2	701	1,448
Park	5	316	786	5	147	278
Platte	3	74	147	3	58	102
Sweetwater	1	W	W	1	729	1,149
Uinta	1	W	215	1	W	302
Weston	1	W	2	1	1	4
Undistributed[1]	10	897	1,772	8	919	2,423
Total[2]	46	5,101	11,240	38	5,265	11,419

W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
[1] Includes Big Horn, Campbell, Sheridan, Sublette, Teton, and Washakie Counties.
[2] Data may not add to totals shown because of independent rounding.

Sodium Carbonate.—In the biennium 1978-79, Wyoming again was the Nation's principal producer of natural soda ash, the major nonfuel mineral produced in Wyoming. Natural soda ash was produced from the mineral trona, which consists of sodium carbonate compounds and water; the largest known minable deposits of trona in the world are in southwestern Wyoming. The State Inspector of Mines reported about 11.4 million tons of trona was mined in 1978, 12.8 million tons in 1979. Processed trona yielded about 55% soda ash, about 6.2 million tons of soda ash in 1978 and 7.0 million tons in 1979. About 3,500 people were employed in Wyoming trona production in 1978, 3,900 in 1979.

An estimated 67 billion tons of minable trona is believed to underlie 1,400 square miles of Federal, State, Union Pacific Railroad Co., and other private lands west of Green River in Sweetwater County. Various companies and individuals in the Green River basin held 45 Federal sodium leases for trona comprising over 77,000 acres.

Four trona mines and refineries produced Wyoming soda ash in 1978-79: Allied Chemical Co., Alchem Mine; FMC Corp., Westvaco Mine; Stauffer Chemical Co., Big Island Mine; and Texasgulf, Inc., Granger Mine. Tenneco Oil Co. began constructing the area's fifth trona mine in late 1979. All mining was underground, with modified room-and-pillar systems. Stauffer used a conventional shear-cutting, drilling, blasting, shuttle-car belt-haulage method; Texasgulf used continuous miners exclusively; FMC used both, plus three large boring machines; and Allied Chemical used a long-wall system in addition to conventional methods and continuous miners.

FMC, the largest and oldest of the four soda ash producers, began mining trona in 1952. After a major expansion in 1976, FMC produced about 2.5 million tons of soda ash in 1978 and again in 1979, employing about 1,300 people each year; about 700 were underground miners. All mine workings are on one level, 1,500 feet below the surface. In December 1979, FMC announced a major technological breakthrough in developing a solution-mining technique which would reduce costs in trona mining. Solvents would be injected into trona beds 50 to 100 feet underground to dissolve minerals, which would then be pumped to the surface. With this method, it is anticipated 150 people could produce 1 million tons of soda ash compared with 450 people required with current methods. FMC received approval to mine under portions of Interstate Highway I-80. The company applied to the Wyoming Department of Environmental Quality for a permit to enlarge its monohydrate soda-ash plant by 250,000 tons of capacity. Energy was supplied from FMC's Skull Point coal mine near Kemmerer.

Allied Chemical employed about 1,200 persons in producing approximately 1.5 million tons of soda ash in 1978, 1.9 million tons in 1979. It converted its steam boilers from natural gas to coal fuel. Plant capacity was doubled to about 2.2 million tons per year in 1975. Between 1976 and 1979, the company spent about $15 million on environmental controls, safety improvements, and monitoring facilities; it also purchased $24 million worth of railroad hopper cars. For future mine expansion, Allied purchased the Phillips leases north of the present mine.

The Stauffer Chemical Co. trona operation, in which Rocky Mountain Energy Co. has a 49% interest, yielded about 1.5 million tons of soda ash in both 1978 and 1979, employing about 600 people. A 300,000-ton refinery-expansion program begun in 1977 was continued through 1978-79 with construction of the evaporator and drying section. Completion is expected in the last quarter of 1980. A 20-foot-diameter circular ventilation and production shaft, to be completed by mid-1980, was sunk to 1,050 feet, with the production level to be at 850 feet. A planned feature of the new ventilation system is the warming of incoming air to 60° by drawing it through a rock maze created in abandoned mining panels.

In its second and third full years of operation, Texasgulf produced about three-fourths of a million tons of soda ash in 1978 and 1 million in 1979. Employment increased from less than 400 in 1978 to more than 450 in 1979; of these, 220 worked underground. The company estimates its reserves at about 175 million tons in two flat-lying beds at depths of about 1,370 and 1,420 feet, averaging nearly 90% pure trona. About one-half of the reserves will be mined under a lease on Union Pacific land, the balance under Federal and State leases. The shortage of hopper cars, a marketing problem for all soda ash producers in 1978, was particularly acute for Texasgulf because allocations were based on usage in the preceding year, a startup year for Texasgulf. An ICC decision ordered that western railroads allocate 70% of available hopper cars for grain shipments. Texasgulf, the only 100% coal-fired, natural soda ash plant, used 375,000 tons of coal annually in drying trona ore. During 1978-79, Texasgulf was in the process of obtaining permits for a mine-plant expansion that would double its soda ash capacity to 2 million tons per year. Current mining was at the 1,370-foot level in the top bed of trona; future mining would also be at a 1,560-foot level.

Construction of a fifth trona operation began in 1979 in the Green River area of Sweetwater County. The Tenneco Oil Co. Mine and Mill is expected to be in operation by mid-1982. Tenneco submitted an application for a mine permit to the Land Quality Division of the Wyoming Department of Environmental Quality November 1, 1978. An Industrial Siting Permit, one of 25 different permits required, was granted April 26, 1979. Brown and Root, Inc., was selected as prime contractor for both plant and mine. With a design capacity of 1 million tons per year of soda ash, and a standard room-and-pillar mining method, the permanent work force of the mine is expected to be 350. The operation is expected to consume up to 330,000 tons per year of coal for calcining and steam generation.

Church and Dwight Co., Inc., was the only locally sited, direct-consumer manufacturing firm based on the State's trona industry. With completion of a $9.4 million expansion program in 1977, its Green River plant produced about 150,000 tons of baking soda in 1978 and again in 1979, or about one-half of all the baking soda marketed by Church and Dwight under their Arm & Hammer brand name. Claimed to be the largest sodium bicarbonate processing plant in the world, the plant employed about 135 people.

About 95% of the Nation's natural soda ash was produced in Wyoming in 1979. Searles Lake, Calif., was the only other source. Natural soda ash provided about 85% of the U.S. soda ash consumption in 1979, up from about 25% in 1970. Increasingly burdened by rising fuel and environmental costs, synthetically produced soda ash made by the Solvay Process (combining salt and limestone) appears no longer able to compete with Wyoming soda ash. Two Solvay plants were operated in the United States in 1978; only one remained after November 1979. Capacity estimated at 3 million tons has been lost in the past 5 years through closing of Solvay Process plants. Wyoming soda ash, priced at $55 per ton in 1978 and $66 per ton after April 1979, was still competitive in eastern markets after adding $30 or more in transportation cost. Nearly 75% of the market for Wyoming soda ash was east of the Mississippi River—notably in Indiana and Ohio glass-producing areas. In addition to glass production, which consumed 55% of production, soda ash was used in chemicals (9%); paper and pulp (5%); pharmaceuticals; photographic, metallurgical, and petroleum refining products; and polllution controls such as stack scrubbers and water treatment plants. The Solvay process is the predominant source of soda ash outside the United States, with very little natural soda ash produced. Consequently, Wyoming producers began investigating overseas markets during the biennium.

Stone.—Ten operators (including the U.S. Forest Service) produced stone at 13 quarries in 8 counties in 1978. In 1979, 10 companies, 7 of which were the same as those producing in 1978, worked 16 quarries in 7 counties. Producing counties were Albany, Crook, Laramie, Lincoln, Platte, Sublette, and Teton, with Uinta having production in 1978 but not 1979. Almost the entire output was classified as crushed stone, although a minor amount of dimension stone was also produced in 1978. Limestone predominated with about two-thirds of the tonnage of crushed stone produced; granite contributed between one-quarter and one-third, marble and other stone a minor amount. Because of lower unit values, the portion of total value for limestone and granite was smaller, whereas the higher value marble was more significant in total value than in tonnage. Limestone was mined from nine quarries and granite from two; four quarries yielded marble and other stone.

Platte County was the leading source of stone, followed by Laramie and Albany Counties. Combined output of the three counties in both years was about 90% of the State total. One-half of the limestone and nearly all of the granite produced was used as railroad ballast. Unspecified aggregate was the second major use, with lesser amounts going to cement manufacture, concrete aggregate, roadbase, and sugar refining.

The value of crushed rock produced ranged from $1.16 per ton for unspecified limestone aggregate ($1.17 in 1979) to $30.00 for marble terrazzo ($34.00 in 1979). The average price for crushed rock was $2.55 in 1978 and $2.78 in 1979.

Four quarries each produced less that 25,000 tons per year in 1979; 12, less than 200,000 tons per year; one, just over 300,000 tons per year, one, more than 600,000 tons per year; and two, more than 900,000 tons per year. In both years, the largest three quarries produced nearly three-fourths of Wyoming's crushed rock. About three-fourths was transported to point of use by railroad, mostly rock for railroad track ballast.

Leading producers in 1979 were the Guernsey Stone Co., operating one limestone quarry in Platte County, which yielded nearly 45% of total State output; and Morrison-Knudsen Co., Inc., and the Union Pacific Railroad Co., which mined granite at one quarry each. Basins Engineering Co., Inc., the only producer of marble, marketed its white-marble product nationwide for use as colored aquarium and planter chips, in landscaping, and in precast building-wall panels, roofing, terrazzo, and swimming pool plastering. The large increase in stone production between 1978 and 1979 appeared to be the result of increased demand for railroad ballast. Increased use also was seen in cement manufacture, concrete aggregate, and road base. In 1979, a smaller amount of limestone went to sugar refining than in 1978.

Sulfur.—Sulfur was produced in Wyoming in 1978-79 as a byproduct of sour natural gas production by four companies in five counties: Carbon, Fremont, Laramie, Park, and Sweetwater. Nearly 90% of production came from Park and Sweetwater Counties, with Park the dominant source. Closely related to natural gas production, the volume of sulfur production was very nearly the same in 1979 as in 1978, although a larger amount was sold or used in 1979. Western Nuclear, Inc.'s, Riverton plant in Fremont County, produced about 300 tons of sulfuric acid per day for use in leaching uranium ore.

METALS

Gold.—No gold production was reported for Wyoming in 1978-79. Very little organized gold-mining activity has been occurring in Wyoming over the past 112 years, although a few entrepreneurs and hobbyists have kept the interest alive. Increased gold prices in 1978-79, however, renewed interest in the State's gold potential. Homestake Mining Co. took options on a number of dormant properties and staked claims to some open ground in the Atlantic City-South Pass area of Fremont County in 1978 and 1979.

Gold was first discovered in the 1840's in stream gravels in the Sweetwater District of Fremont County. Lode deposits were discovered in 1867, and the peak mining activity took place between 1869 and 1974. Old mines in the area reportedly contained ore with values of one-half ounce per ton. Gold was eventually found in all the mountain ranges of Wyoming, with mines opened in the Wind River Range, Medicine Bow Range, and in the Sierra Madre mountains. These early mines were shallow with little development or exploration below 400 feet.

Gold mining was never developed in Wyoming to the extent that it was in a number of neighboring States; the Wyoming Geological Survey has estimated the total value of gold recoverable in Wyoming over the years at less that $6 million.

Iron Ore.—Iron ore was produced at two mines in 1978-79—the Atlantic City Mine, in the southern Wind River Mountains near Lander, Fremont County, and the Sunrise Mine at the southern end of the Hartville Uplift near Guernsey in Platte County.

The U.S. Steel Corp. Atlantic City Mine produced an iron silicate or taconite ore in an open-pit operation, beneficiated and pelletized the ore near the mine site, and shipped the product 355 miles by rail to its Geneva Steel Works near Provo, Utah. According to a report in Skillings' Mining Review[a], 1.7 million tons of pellets were shipped in 1978, a moderate decrease from the 1977 level of output and slightly higher than that of 1979. Proved reserves of taconite ore have been estimated at 60 to 90 million tons, with as much as 250 million tons in indicated reserves. Based on current production levels, these reserves are sufficient to keep the mine operating for 15 to 20 years. The operation employed about 550 people in 1978-79—150 in the mine itself, the rest in maintenance and in ore concentration and agglomeration. The Atlantic City Mine, at an 8,300-foot elevation near the top of a mountain pass, was established during World War II as part of a national-resource decentralization effort. The beneficiation process involved crushing the ore to a fine powder, magnetically separating to concentrate the iron, combining with bentonite, and heating to produce small hardened pellets about 1/2 inch in diameter; this increased the iron content from 30% as mined to about 60% as shipped.

CF&I Steel Corp. owns and operates the Sunrise Mine, in Platte County, one of only a few underground iron mines still being worked in the United States. Its output, an iron oxide or hematite ore, was crushed and concentrated on site and shipped by rail 330 miles south to CF&I's steel plant at Pueblo, Colo. The mine began as an open-pit copper mine in the 1880's; the high-grade but shallow copper was rapidly worked out. The more extensive iron ore deposits remained unworked until CF&I acquired the claims in 1898. Iron ore production has been continuous since 1901. The mine was converted to a block-caving underground operation in the 1930's. The lowest production level was 750 feet below the surface. An ore beneficiating plant was built in 1944; an addition to the plant in 1976 began beneficiating the finer fractions of ore which formerly had been direct-shipped after drying. An open pit operation, the Chicago Pit, was reopened in 1975. Skillings' Mining Review[a], reported shipments from the Sunrise at 439,495 net tons of beneficiated ore in 1978. This tonnage was a moderate increase over that of 1977, followed by a moderate decline in shipments and a substantial decline in production in 1979. Historically, the Sunrise has produced about 500,000 tons per year. Thirty years or more of hematite iron ore reserves, 23 million tons, was estimated remaining at the Sunrise Mine. About 250 people were employed during the 1978-79 period. Sunrise supplied about one-third of the iron ore requirements of the CF&I steel mill.

Wyoming was fourth in the Nation in iron ore production in 1978, fifth in 1979. It was the most important source of iron ore in the intermountain west, but its output was only about 2-1/2% of the Nation's total. Because the future of Wyoming's two iron ore mines remained tied to the steel companies which own them, they are subject to economic forces outside the State. In 1979, U.S. Steel was negotiating with the Environmental Protection Agency on air pollution standards to be applied to its Geneva Steel Works; it was given until 1982 to comply with the EPA rulings. U.S. Steel has stated that the cost of compliance would make the Geneva plant uneconomical to operate. Outcome of these negotiations will affect the Atlantic City Mine. Similarly, market conditions affecting the CF&I steel mill at Pueblo, Colo., will have repercussions on the Sunrise Mine in Wyoming.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Cement:			
Monolith Portland Midwest Co.[1]	Box 40 Laramie, WY 82070	Plant	Albany.
Clays:			
American Colloid Co	Box 818 Belle Fourche, SD 57717	Pits and plants	Big Horn, Crook, Weston.
Dresser Minerals, a Division of Dresser Industries, Inc.	Box 832 Greybull, WY 82426	do	Big Horn.
Federal Bentonite, a division of Aurora Industries, Inc.	1019 Jericho Rd. Aurora, IL 60506	do	Crook and Weston.
International Minerals & Chemical Corp.	5401 Old Orchard Rd. Skokie, IL 60076	do	Crook.
Kaycee Bentonite Corp	Box 9 Mills, WY 82644	do	Johnson, Natrona, Washakie.
NL Industries, Inc	Box 1675 Houston, TX 77001	do	Crook and Weston.
Wyo-Ben Products, Inc	Box 1979 Billings, MT 59103	do	Big Horn.
Gypsum:			
The Celotex Corp	1500 North Dale Mabry Tampa, FL 33607	Surface mine and plant.	Park.
Georgia Pacific Corp	900 SW. 5th Ave. Portland, OR 97204	do	Big Horn.
Wyoming Construction[2]	Box 907 Laramie, WY 82070	Surface mine	Albany.
Iron ore:			
CF&I Steel Corp	Box 316 Pueblo, CO 81002	Underground mine and plant.	Platte.
United States Steel Corp	Lander, WY 82520	Open pit mine and plant.	Fremont.
Lime:			
The Great Western Sugar Co.[2]	Box 5308 Denver, CO 80217	Plant	Big Horn.
Holly Sugar Corp	Holly Sugar Bldg. Colorado Springs, CO 80902	do	Goshen and Washakie.
Sand and gravel:			
Casper Concrete Co	Box 561 Casper, WY 82601	Pit	Natrona.
Gilpatrick Construction Co., Inc	Box 973 Riverton, WY 82501	Pit	Sublette.
Peter Kiewit & Sons Co	Box 1009 Sheridan, WY 82801	Pits	Natrona and Sweetwater.
Teton Construction Co	Box 3243 Cheyenne, WY 82001	Pit	Laramie.
Sodium carbonate:			
Allied Chemical Corp	Box 551 Green River, WY 82935	Underground mine and plant.	Sweetwater.
FMC Corp	Box 872 Green River, WY 82935	do	Do.
Stauffer Chemial Co. of Wyoming	Box 513 Green River, WY 82935	Strip mine	Do.
Texasgulf, Inc	Box 100 Granger, WY 82934	do	Do.
Stone:			
Guernsey Stone Co	Box 337 Guernsey, WY 82214	Quarry	Platte.
Morrison-Knudsen Co., Inc	Box 7808 Boise, ID 83729	do	Laramie.

[1] Also clays.
[2] Also stone.

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[1] State mineral specialist, Bureau of Mines, Denver, Colo.

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